HUDSON BAY EXPLORING EXPEDITION

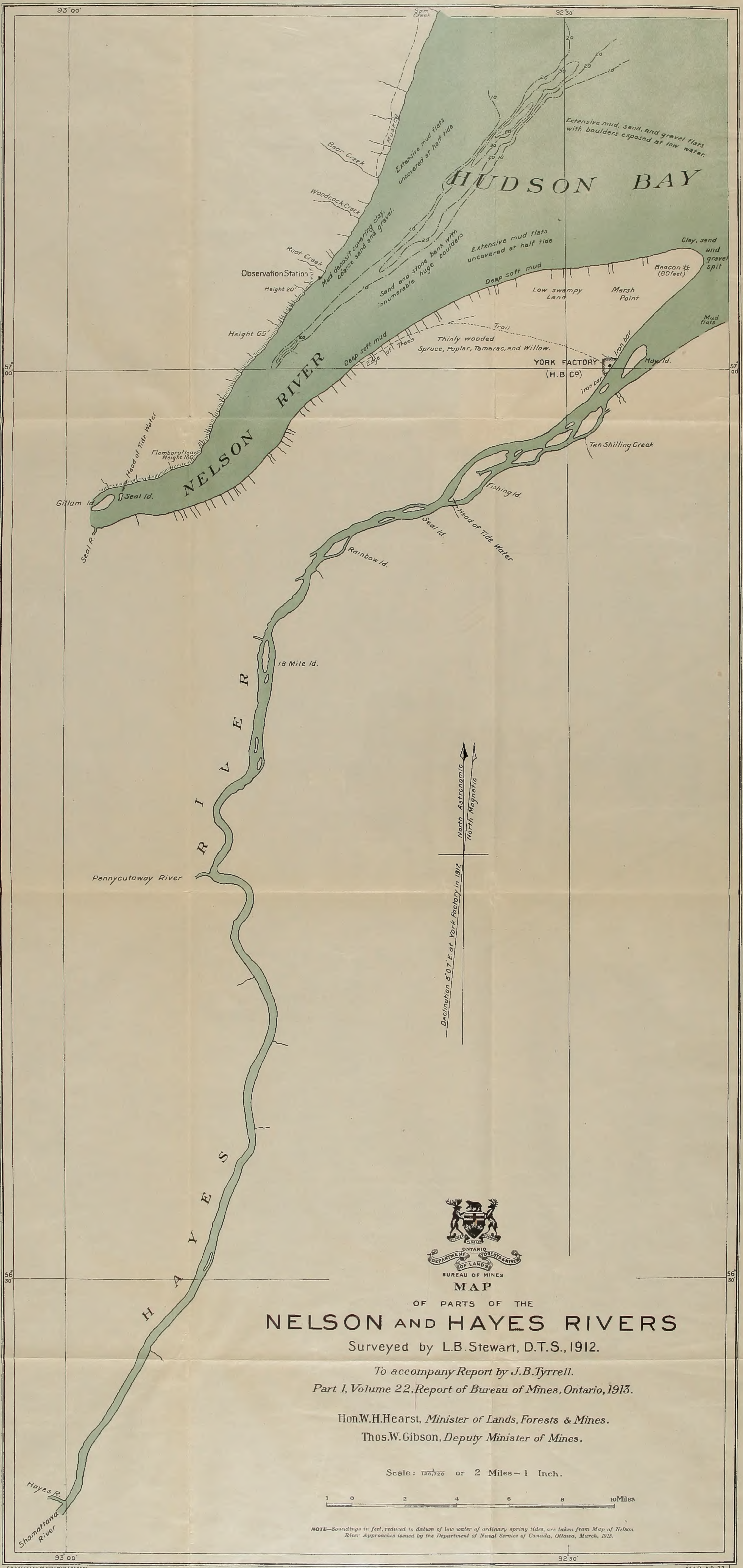
1912

BY

J. B. TYRRELL

M.A., M.Inst.M.M., F.G.S., &c.

Reprinted from the 22nd Report of the Ontario Bureau of Mines,
1913


MAP
OF PARTS OF THE
NELSON AND HAYES RIVERS
Surveyed by L.B. Stewart, D.T.S., 1912.
To accompany Report by J.B. Tyrrell.
Part 1, Volume 22, Report of Bureau of Mines, Ontario, 1913.
Hon. W.H. Hearst, Minister of Lands, Forests & Mines.
Thos. W. Gibson, Deputy Minister of Mines.
ONTARIO
DEPARTMENT OF LANDS FORESTS & MINES
BUREAU OF MINES
Scale: 1/126,720 or 2 Miles – 1 Inch.
10 Miles
NOTE—Soundings in feet, reduced to datum of low water of ordinary spring tides, are taken from Map of Nelson River Approaches issued by the Department of Naval Service of Canada, Ottawa, March, 1913.
HUDSON BAY
NELSON RIVER
HAYES RIVER
YORK FACTORY
(H.B. Co)
Observation Station
Gillam Id.
Seal Id.
Seal R.
Head of Tide Water
Flamboro Head
Height 100'
Height 65'
Height 20'
Root Creek
Woodcock Creek
Bear Creek
Muskeg
Sam Creek
Extensive mud flats uncovered at half tide
Extensive mud, sand, and gravel flats with boulders exposed at low water.
Mud deposit covering clay, coarse sand and gravel.
Sand and stone bank with innumerable huge boulders
Deep soft mud
Edge of Trees
Thinly wooded
Spruce, Poplar, Tamarac, and Willow.
Trail
Low swampy Land
Marsh Point
Beacon (80 feet)
Clay, sand and gravel spit
Mud flats
Iron bar
Hay Id.
Ten Shilling Creek
Fishing Id.
Rainbow Id.
18 Mile Id.
Pennycutaway River
Hayes R.
Shamattawa River
North Astronomic
North Magnetic
Declination 5°07' E. at York Factory in 1912
93°00'
92°30'
57° 00'
56° 30'
E.H. HARCOURT CO. LTD. LITHO TORONTO
MAP No 22

With the Compliments of

J. B. Tyrrell

534 Confederation Life Building

Toronto

Canada

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Itinerary

On the 18th of April 1912 I received instructions from The Honourable the Minister of Lands, Forests and Mines of the Province of Ontario to organize a party, including a properly qualified Dominion Land Surveyor and assistants, and to proceed at as early a date as practicable direct to Port Nelson at the mouth of the Nelson river on Hudson Bay, and after due investigation to carefully select the lands, waterfront and easements to which the Province of Ontario is entitled under an agreement with the Province of Manitoba, ratified by an Order of the Privy Council of the Dominion of Canada, dated the twentieth of February, 1912.

After these lands had been selected, they were to be properly and accurately surveyed.

As much information as possible was to be obtained about the strip of country lying within fifty miles of the shore of Hudson Bay and extending from the southeastern bank of Nelson river to the western boundary of the Province of Ontario.

And, finally, if possible, I was to return home through that part of the District of Keewatin added by the Act of Parliament of Canada of last session to the Province of Ontario, and now known as the District of Patricia, obtaining such general information as to the character, resources and possibilities of this district as it might be possible to procure in the time at my disposal.

In accordance with these instructions, I engaged Professor Lewis B. Stewart, Professor of Surveying and Geodesy in the University of Toronto, as surveyor, and Mr. W. B. McPherson, B.Sc., as assistant surveyor and chainman, and at the same time made arrangements for an assistant geologist to go by ship to Port Nelson in order to accompany me on my journey home through the District of Patricia. I also engaged Mr. Hugh McDiarmid, of Maxville, Ontario, who had already spent some years on Hudson Bay, as a chainman and canoeman.

On the twenty-seventh of May, 1912, accompanied by Messrs. Stewart and McPherson, I left Toronto and proceeded to Nepigon, where, through the kind assistance of Mr. William McKirdy, four good Indian canoemen were secured, and thence the party proceeded to Selkirk, Manitoba. Here it was necessary to wait for a few days, for the steamboats declined to start for the north end of Lake Winnipeg until it was reasonably certain that the ice had disappeared from it. On the fourth of June we took passage on the steamer "Wolverine," belonging to the Northern Fish Company, and started from Selkirk. The boat was loaded with fishermen and their supplies for the summer, and it was necessary for us to stop at several fishing stations on the shore and islands of Lake Winnipeg on the way north. Nevertheless, we reached Warren's Landing, at the north end of this lake, where the Nelson river flows out of it towards Hudson Bay, on the morning of the sixth of June, and on the afternoon of the same day we continued down the Nelson river to Norway House, where the Hudson's Bay Company has one of its oldest and most important trading posts.

Here it was necessary, if possible, to obtain two more canoemen, for we had three canoes and I needed to have two expert Indian canoemen in each canoe. We had already obtained four such men at Nepigon, but they knew nothing of the waters ahead of them, and I had purposely refrained from engaging more canoemen in Nepigon in order to be able to take two men from Norway House who knew the river from there to York Factory, with its rapids, falls and portages.

Unfortunately others wanted to go to Hudson Bay as well as ourselves. The number of canoemen at Norway House was limited and there was keen competition for them, so that a delay of several days occurred here before men could be obtained. As far as possible the time was employed in correcting instruments and getting everything in order for immediate work when we should reach the field of our proper labours.

Photo by J. B. Tyrrell, July 23, 1912.
Camp at extreme high tide, east shore of Nelson river.

Norway House to Hayes River

Having at length engaged two Indians, we left Norway House on the morning of the twelfth of June in three canoes, with such provisions as would be necessary to supply us for a month, and started northward down the Nelson river to the mouth of the Echimamish, up the Echimamish to its head, across the narrow rocky divide which bounds the waters of the Nelson river on the east, and then down the Hayes river to York Factory, the great historic trading post of the Hudson's Bay Company, built on the west bank of the river near its mouth, making a track-survey of our route, the distances on the rivers and smaller lakes being estimated, while the lengths of the larger lakes were measured with a boat log.

The Shamattawa river flows into the Hayes river sixty miles from where this latter stream empties into Hudson Bay, and as we were to explore a strip fifty miles wide from the shore of the Bay southward I decided to begin our survey at this point. Professor Stewart therefore began a careful survey of the Hayes river downwards from the mouth of the Shamattawa, taking his bearings from the true meridian with a transit, and measuring his distances with a rod and stadia hairs, checked in several places by careful chainage. This survey, which shows both banks of, and the islands in, Hayes river, as well as the mouth of the Nelson river, is shown on the annexed map on a scale of 10 miles to an inch.

At the same time I went up the Shamattawa river for a few days to investigate the character of the country through which it flows.

Our journey from Norway House to the mouth of the Shamattawa, a distance of 260 miles, had been rather slow, as we were constantly delayed by head winds and stormy weather, but on the twenty-seventh of June Professor Stewart started his survey downwards from that point and continued it from that time until July 12th, when he reached the mouth of Hayes river. During the latter part of the time in which Professor Stewart was so occupied, I was at York Factory and on Nelson river making investigations as to the character of the surrounding country, and also of the country extending eastward, obtaining all the information that it was possible to obtain from the Indians who have their hunting grounds in this latter district.

Photo by J. B. Tyrrell, July 25, 1912.
Shore at low tide on the east side of Nelson river. Beach of rounded gravel.

Locating Ontario's Frontage

After Professor Stewart had made the survey of the Hayes river from the Shamattawa river to its mouth, he continued it round the point which separates that stream from the Nelson river, up Nelson river to Seal Island and down its west shore to Flamborough Head. As soon as this was completed I chose a frontage of ten miles on the east side of Nelson river, and Professor Stewart marked it with proper posts and mounds, which I also signed with him. We then cut lines back through the forest for a distance of a mile at the north end of the ten mile strip, and for five and a half miles at its south end, the eastern portion of this latter line crossing the Hayes river and connecting with the stadia survey which had been made of the banks of this latter stream.

After choosing the frontage for the Province of Ontario on the Nelson river it was necessary, in outlining a strip of land five miles wide from that frontage eastward to the western boundary of Ontario, to find a feasible crossing place for a railway across the Hayes river. On account of the shifting character of the channel of this stream near its mouth, and of the enormous floods and ice-jams to which it is occasionally subjected in the spring, such a crossing place could not be found nearer than thirty-three miles from Hudson Bay, not far from the junction of a tributary called the Pennycutaway river which empties into the Hayes river from the west.

Therefore, as it was necessary to go up the Hayes river at least 33 miles before a crossing for a railway could be found, it was also necessary for me to bend the five-mile strip of land southward from the mouth of the Nelson river along the west side of the Hayes river at least as far south as the mouth of the Pennycutaway, and the survey of this strip so chosen was marked by substantial posts at various conspicuous places, as shown on the accompanying map of the lower portions of the Hayes and Nelson rivers.

It was impossible for me to explore the strip of land eastward from the Hayes river to the boundary of the Province of Ontario in the remaining time at my disposal, but I made a trip in a canoe up the Machichi or Fourteen river, which flows northward into

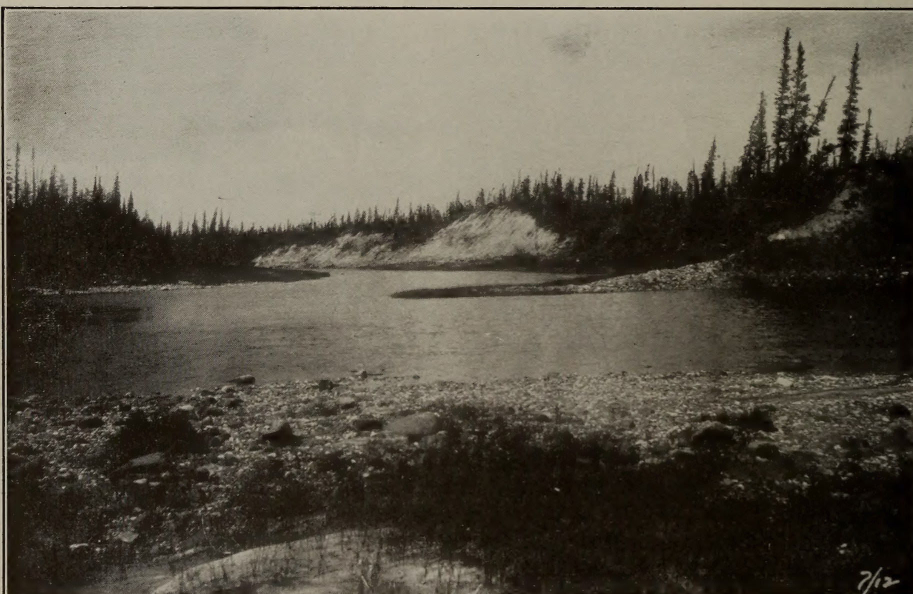


Photo by J. B. Tyrrell, Aug. 17, 1912.
Machichi river east of Hayes river, showing cliffs of till.

Hudson Bay across the country to the east of Hayes river, and obtained a fairly clear idea of the character of the country along its banks. This information, along with such other information as I was able to obtain from Indians and white men living in the country and from an inspection of the shore of the Bay itself, is set down on a later page of this report and on the accompanying map.

By the time Professor Stewart had completed the survey of the land chosen for the Province of Ontario in the vicinity of the mouth of the Nelson and Hayes rivers the summer was almost over, and it was necessary for him to return to Toronto to resume his duties at the University, so, accompanied by Messrs. W. B. McPherson and H. McDiarmid and the Indians from Norway House, he returned up the Hayes river to Norway House and thence down Lake Winnipeg to Selkirk and home to Toronto.

On the twentieth day of August the steamship "Stanley" arrived at York Factory, bringing Mr. P. E. Hopkins as assistant to accompany me on my journey homeward.

The annual steamer which brings out the supplies for the Hudson's Bay Company at York Factory had not yet arrived, and some lines of supplies, especially bacon and meat, had run short at this central depot. Consequently the Company was prevented from furnishing the usual supply of meat to its trading posts on the Severn river, which I was about to visit. This was particularly unfortunate for us, because the bacon which had been sent to me on the steamer "Beothic" and delivered to me at the mouth of the Nelson river, was almost all decomposed and quite unfit for use when it was delivered. In spite of its bad condition, however, we were obliged to do the best we could with it and to use parts of it.

From York Factory Home via Severn River

On the twenty-sixth of August I left York Factory, accompanied by Mr. Hopkins and the four Indian canoemen from Nepigon, with two canoes, and took passage in a small sail-boat of the Hudson's Bay Company along the shores of Hudson Bay to Fort Severn, where we arrived eight days later.

On the 4th of September we started southward from Fort Severn in our two canoes heavily laden with provisions, for it was uncertain when or where we would be able to get any further supplies. We ascended the Severn river, hauling our canoes with lines, a distance of fifty-six miles, to the mouth of the Fawn river, which is a beautiful clear stream 150 yards wide at its mouth, with terraced banks 80 feet in height. Thence

Photo by P. E. Hopkins, Aug. 28, 1912.
Shore of Hudson Bay, near Cape Tatnam.

we ascended Fawn river, walking on the bank and hauling our canoes as before for a further distance of 180 miles, but through much of this distance the journey was made very laborious by the fact that the weather was rainy and stormy and the river was swift, deep and narrow, and overhung with tall willows, so that our progress was often very slow, the tracking line being constantly entangled in the overhanging willows. Fifteen days were occupied in this journey, and at the end of that time we welcomed the occurrence of heavy rapids, past which it was necessary to carry our canoes and supplies, but between which the water was not so swift as before, and it was possible to make some progress with our paddles.

Trout Lake

On the twenty-first of September Trout lake was reached and we had the pleasure of meeting Mr. H. C. Moir, the gentleman who is in charge of the Hudson's Bay Company's trading post for that Company. Here we were able to replenish our supply of flour, but it was impossible to obtain any meat, and our own supply of meat at that time consisted entirely of partly decomposed bacon.

Up to this time we had travelled from Severn House without anyone who had any local knowledge of the country, and guided entirely by the map on the scale of sixteen miles to the inch published by the Geological Survey of Canada. From Trout lake southward across the height of land to Cat lake, on the waters of the Albany river, the route

Photo by J. B. Tyrrell, Sept. 4, 1912.
Dwelling house at Fort Severn, near the mouth of Severn river, District of Patricia, Ontario.

Photo by P. E. Hopkins, Sept. 24, 1912.
Hudson Bay Company's post at Trout lake, District of Patricia, as seen from the lake.

travelled by the Indians was not known, and as we wished to follow it, it was advisable, if possible, for me to employ an Indian here to go with us and show us the way by which he was accustomed to travel. The Indian obtained for us by Mr. Moir was a man of considerable intelligence named Adam Thunder, and on the morning of September the twenty-fourth we started across Trout lake with Adam and his wife and two children in a canoe of their own as guides.

Making for Cat Lake

From Trout lake we entered a small stream named Mishwamágan or Red Sucker river, and ascended it southward to its source in several small lakes, from one of which we carried our canoes and contents across to Kwiuswagami lake and thence into Makoop lake, which empties by an independent outlet westward into Severn river. Makoop lake is evidently good fishing ground, and some Indians have here two substantial log houses

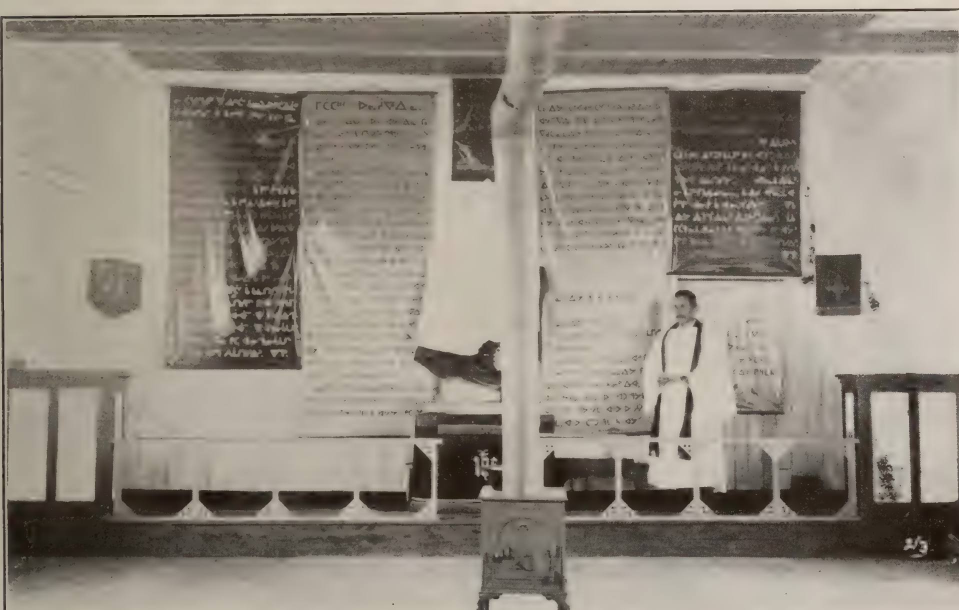


Photo by P. E. Hopkins, Sept. 24, 1912.
Interior of mission church at Trout lake, with Rev. Mr. Dick on right. The Lord's Prayer, etc., in Indian characters.

in which they live in the winter, although they move about from one part of their fishing ground to another in the summer.

From Makoop lake, instead of turning down stream, we entered Negigamo or Otter river and ascended it for a day's journey, when, though it was still a stream of considerable size, we left it and turned westward across a portage somewhat more than a mile in length to another tributary of Severn river, which, at the point we reached it, was ninety yards wide with low swampy banks on both sides.

On this river Adam, our guide, decided to leave his wife and family with some friends or relatives whom he met, and to take a seat in one of our canoes, where he would be more useful to us, both by assisting in paddling, and, being close at hand, he would be able to give us information about the country from time to time as the various features were observed.

This river is also a tributary of the Severn, but Adam said that it had no particular name. I have therefore called it Ningitowa river taking the name of one of the lakes

Photo by P. E. Hopkins, Oct. 17, 1912.

Lunch time on the banks of Cat river.

Photo by J. B. Tyrrell, Oct. 4, 1912.

Woods at the north of unloading portage, north of Weagamow lake.

on its course. We ascended it for three days through many lakes and over numerous portages to a lake with a name too long for intelligent English pronunciation, but it means Big White Fish lake.

From the south side of this lake is a portage twelve hundred yards in length across a rocky hill to a small winding stream which in a short distance flows into Weagamow lake, and this lake in its turn discharges by another independent stream westward into Severn river, and is fed by two streams from the east and south, known respectively as the Caribou and Saskatchewáwa.

Weagamow lake also seems to be a good fishing ground, for there was a large band of Indians camped near the place where we entered it, engaged in catching a supply of fish to feed them through the autumn and winter.

From Weagamow lake I had hoped that our route was to take us down stream to the Severn river and thence southward up the main river, but in this I was disappointed,

Photo by J. B. Tyrrell, Oct. 7, 1912.
Sandy shore of Windigo lake.

for instead of turning down stream we entered Saskatchewáwa river and ascended it to a small lake named Agutua lake, from which a number of high sand hills may be seen forming conspicuous features in the landscape.

Windigo Lake

From the southwest side of this lake we made a portage three and a half miles in length, over one of these sandy hills to Windigo lake, the largest body of water that we had encountered since leaving Trout lake. This, too, is a favourite fishing ground for the Indians, and on its eastern shore they have some small houses around which were gardens, where potatoes had been grown, though at the time of our visit they had been dug and were stored away. Windigo lake also discharges westward into the Severn river by an independent stream, which, however, we were unable to visit, but we were told by Adam that it flowed westward to Niskib or Goose lake, in which it was joined by Weagamow river, and from which the united streams flowed into Severn river. Passing through the lake we ascended a small river for about fifteen miles, when, by a series of long portages, we passed out of it and into the Cedar branch of the Severn river, which we reached at Little Cedar or Geechika lake, the northern limit of growth of cedar trees.

Thus, on leaving Trout lake, we had ascended a small stream to the higher land lying between the watersheds of the Severn and Wenisk rivers, on which are a number of lakes, and we had travelled southward on the western side of the height of land through a chain of lakes, instead of travelling continuously up the main branch of the Severn river. This route leads through small streams and over many long and swampy portages which are often poorly cut out, but the reason why it is used by the Indians instead of the main river doubtless is that it leads through lakes in which fish are abund-

Photo by J. B. Tyrrell, Oct. 9, 1912.
Sandy shore of Geechika or Little Cedar lake, with small cedar tree just behind the figure.

ant, and where game is probably moderately plentiful. Whether it is easier for large canoes to navigate than a route up the main river is uncertain, because the river is as yet largely unexplored.

From Little Cedar Lake we journeyed southward up a small winding stream and over many portages to the height of land dividing Severn from Cat river, which is one of the upper tributaries of Albany river.

Cat Lake

On the thirteenth of October, we paddled up to the Hudson's Bay Company's post on Cat lake, and were kindly received by Mr. Lawson, the store-keeper in charge for the Company, and, as he was supplied with provisions for the winter's trade, we were able to get such staples from him as were necessary to carry us through to our destination at Sioux Lookout, on the Grand Trunk Pacific railway. A supply of nice fresh bacon was particularly welcome, as we had become very tired of living on rotten bacon, and besides we had that day eaten the last of both that and our sugar, so that we were quite ready for a new supply.

We were now in the country that had previously been surveyed by explorers from the Geological Survey of Canada, and, as the season was far advanced, we made all haste southward down Cat river to Lake St. Joseph, across a portage to Root river, down Root river to Lác Seul, and thence southward to Sioux Lookout, where we arrived on the evening of the twenty-third of October, seven weeks from the date when we left the mouth of the Severn river. Here our canoes were stored, the men were taken eastward to Nepigon and paid off, and I and my assistant, Mr. Hopkins, returned to Toronto.

Surveys

During the season the following surveys were made, namely:

Survey of the mouth of the Hayes and Nelson rivers, with transit and chain, rod and stadia .... 110 miles.

Photo by P. E. Hopkins, Oct. 14, 1912.
Our canoemen after arrival at the Cat lake trading post, with the trader and his boy on the right.

Track surveys where the distances on running water were estimated; on quiet water were measured with a Kay boat log; the lengths of portages were measured by pacing; the directions were taken with a compass checked by numerous observations for variation; and the whole survey was checked by numerous observations for latitude taken in a mercurial artificial horizon with a sextant of 7-inch radius.

		miles.
Echimamish river	water	36
	2 portages	
Hayes river, from source to Shamattawa river	water	260
	27 portages	4.25
Shamattawa river	water	40
Machichi river	water	20
	portages or on foot	5
Severn river to Trout lake post	water	285
	17 portages	2.25

			miles.
Severn river and tributaries; above Trout lake post		water	200
		57 portages	19.75
Albany river waters		water	20
		10 portages	3
In addition to which we examined the following routes, though without making definite surveys:			
Shore of Hudson Bay, Nelson river to Severn river			240
Albany and Winnipeg rivers		water	180
		19 portages	2.75
Total			1,428.00

DISTRICT OF PATRICIA

Physical Features

The District of Patricia is situated a short distance east of the geographical centre of Canada, between north latitudes 50° and 57°, and west longitudes 81° 30′ and 95° 15′, being bounded on the west by the Province of Manitoba, on the south by the older districts of Ontario, from which it is separated by the Albany and Winnipeg rivers, and on the north and northeast by Hudson Bay.

It is roughly triangular in shape, with a greatest length in a N.E-S.W. direction of 630 miles, and a greatest width in a N.-S. direction of 390 miles, and it has an approximate area of 150,000 square miles, or about one-fourth larger than the combined areas of Great Britain and Ireland.

It lies entirely within the drainage area of Hudson Bay, most of its surface being drained directly into the Bay through the Severn, Winisk, Trout, Ekwan, Attawapiskat and Albany rivers, though there is a small area in the southwestern portion of the district which is first drained westward into Lake Winnipeg, before its waters find their way by the Nelson river into Hudson Bay.

It has a shore line on Hudson Bay of 600 miles. The shore is low and flat, and for most of its length is marked by a beach of sand and gravel. From this beach the water recedes for a long distance at low tide, leaving a tidal flat which in places is hard and sandy, while in other places, especially near the mouths of rivers, it is soft and muddy, and is often dotted with boulders.

Back from the beach the land rises very gently in an alternating series of marshes and gravel ridges, the latter of which represent old shore lines when the land was lower than it is at present. The marshes are covered with grasses and sedges, for the forest does not usually descend below a line several miles distant from high water mark.

Low points of limestone are said to be exposed on the shore west of Cape Henrietta Maria, but elsewhere the beach is of sand, gravel, or mud, without sign of rock in place.

The District is a fairly distinct physiographic unit with its highest portion, consisting of a rocky granitic plateau with an elevation of 1,500 feet above the sea, in north latitude 52°, west longitude 92°. From this elevated area all the principal rivers in the district take their rise, and radiate to the several points of the compass, though the water from all of them finally reaches Hudson Bay.

Last summer our course across the district from the mouth of the Severn river to Lac Seul took us over the highest portion of this elevated area, the distance in a straight line between the extreme points being 440 miles, though the actual distance travelled would nearly double this figure.

From the highest point of land crossed, which has an elevation as determined barometrically of 1,470 feet, the country slopes gently southward to Lac Seul, at the average rate of three feet to the mile, and throughout the distance the surface is exceedingly rocky, with occasional sand plains and ridges. Lakes are very numerous, being simply bodies of water filling the depressions in the rocky surface.

North of the highest point of land the country slopes northward at an average rate of five feet to the mile. For the first hundred and fifty miles down this gentle slope the surface is often rough and irregular, with many sandy or stony hills and occasional rocky ridges, between which the intervening valleys are generally partly filled with clay or sand. Lakes are not as large or numerous as they are south of the high land, and such as do exist lie in shallow basins in the glacial clays, and not in rock basins, while most of the land between the waterstretches consists of clay, sand or glacial debris of some kind with low surface relief. The country is well watered, but the general impression which prevails with regard to the character of much of northern Canada, namely, that it is an extensive rocky country with bodies of water lying between the rocky hills, does not often apply here. To the south of the high land such is the character of much of the country, but to the north of it the rock basins are mostly filled with surface deposits, and the lakes are merely bodies of water filling shallow depressions in these surface deposits, irrespective of the underlying rock.

Trout lake lies near the northern boundary of this broken country with its irregular, variegated surface. From Trout lake northward to Hudson Bay, the slope continues as before at the rate of about five feet to the mile, but the rock soon disappears under glacial and postglacial deposits, and thence northward the country is covered with an even mantle of glacial clay or till, which in its turn is often covered with stratified marine clays and sands holding shells of *Saxicava rugosa*, and other marine bivalves.

Photo by P. E. Hopkins, Oct. 17, 1912.
Indian summer on Cat river, showing characteristic forest on the banks.

Extensive Peat Bogs

As this northern country is very new, geologically speaking, extensive valleys have not been formed in it, and the rainfall has no means of running off except in the narrow, immature channels of the rivers. Consequently great areas are still flat, and practically undrained, and such flat areas are now covered with peat bogs on which grow scattered forests of small stunted spruce and larch.

This boggy plain not only extends to Hudson Bay on the course of the Severn River, but it also stretches northward and westward from the Severn river to the lower portion of the Hayes river, and all the country within fifty miles of Hudson Bay between the western boundary of Ontario and the Hayes river is undoubtedly of this flat, bog-covered character. All the evidence that it was possible for me to collect pointed distinctly and conclusively to the fact that there are no rocky hills anywhere in this fifty-mile strip. However, near the southern boundary of this strip, or more probably a little to the south of it, there is a ridge of sand and gravel with lumpy gravel hills rising on it here and there, and near these hills are several small lakes. It was impossible for me to visit these hills and lakes in the time at my disposal, but the description given to me of them would indicate that they were part of a moraine of the Labradorean glacier which was laid down in water, and was afterwards modified by the action of waves, which gave rise to the formation of beaches. The exact position and character of this ridge should be carefully and thoroughly investigated before a route is finally chosen from the western boundary of Ontario to the Hayes river.

East of the Severn river the plain underlain by glacial clays and marine sediments has been traced by other observers around to the Albany river, and the total area included in it would seem to be about two-fifths of the whole district, or about 60,000 square miles.

Lake Elevations

In order to give a clearer idea of the heights of different parts of the country the following elevations of some of the lakes passed through may be recorded, all the heights, except that of Lac Seul, being determined by readings of an aneroid barometer.

	Feet.
Lac Seul	1,140
Lake St. Joseph	1,220
Smooth Rock Lake	1,300
Cat Lake	1,330
Whitestone Lake	1,390
Height of Land Lake	1,470
Big Cedar Lake	1,400
Little Cedar Lake	1,250
Windigo Lake	1,200
Weagamow Lake	1,000
Trout Lake	770

Hayes River Route:—

Whitewater Lake	695
Oxford Lake	585
Knee Lake	550
Swampy Lake	500

Forest

The district as a whole, as far as could be seen from our line of travel, was not heavily forested. Here and there groves of trees of moderate size were growing on the slopes of hills, or on the well-drained banks of the valleys, but as a rule most of the timber was small, and much of it had been burned in comparatively recent years.

White and Red Pine (*Pinus strobus* and *resinosa*) are growing on sandy flats on the banks of Lac Seul.

Banksian Pine (*Pinus banksiana*) is growing of good size on a sandy plain on the banks of Fawn river below the mouth of Otter river.

Cedar (*Thuya occidentalis*) grows north as far as Little Cedar lake on Severn river, though it was not seen anywhere in great abundance.

Black and White Spruce (*Picea nigra* and *alba*) extend north to within sight of the shore of Hudson Bay.

Larch or Tamarac (*Larix americana*) is associated with white and black spruce to the northern limit of the district, but unfortunately most of the trees are dead.

White Birch (*Betula papyrifera*) is found growing freely as far north as the most northerly outcrops of Archæan rocks, and some scattered trees were seen farther down the Severn river.

Aspen Poplar (*Populus tremuloides*) grows as far north as a sandy ridge a few miles above the mouth of Fawn river, though the trees are there vary small.

Balsam Poplar (*Populus balsamifera*) occurs on the islands and banks of the rivers to within a short distance of Hudson Bay.

Photo by P. E. Hopkins, Sept., 1912.
Tracking up Fawn river. Flat boggy country on both sides.

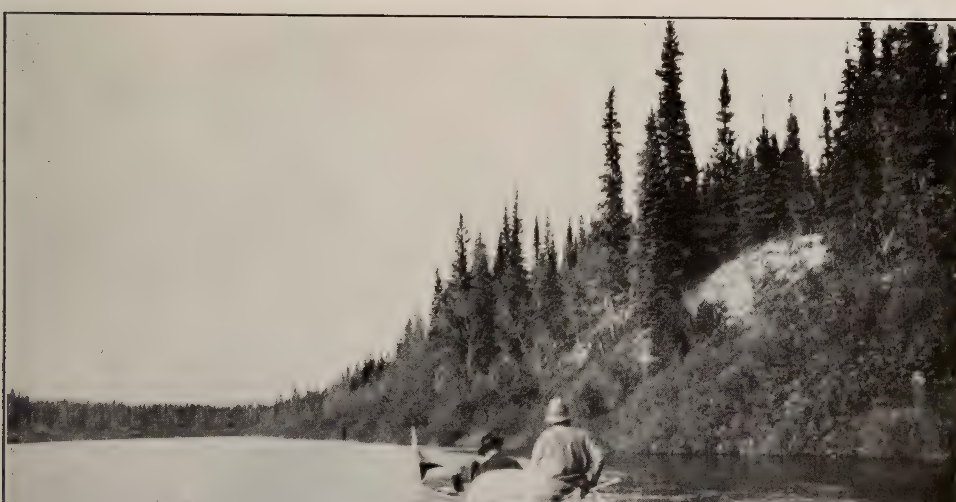


Photo by P. E. Hopkins, Sept., 1912.
Fawn river in high water, showing the bank overhung with willows.

Climate

Little can be said on this subject, as my opportunities for observation were very limited. We left the shore of Hudson Bay on the 4th of September, and had windy and rainy weather for several days, or until we reached the vicinity of the mouth of Fawn river. After that we had some rain almost every day, with intervening periods of bright, clear weather, until we reached Trout lake on the 21st of September. During the last week of this time the leaves of the poplars, birches, and willows had assumed their brilliant autumn colours. In Manitoba the leaves on these trees would be changing colour at the same time.

On the 25th of September, while in the rock country just south of Trout lake, we had a moderately heavy fall of snow, after which, until the 23rd of October, when we reached the Grand Trunk Pacific railway, the weather was bright and mild with a few light showers of rain, but no more snow.

At my suggestion the Director of the Meteorological Service of Canada has consented to establish an Observing Station at Trout lake, so that within a very few years we shall have much more exact information about that important locality.

Inhabitants

The Hudson's Bay Company has a trading post just at the mouth of Severn river, and another at Trout lake, at each of which two white men are stationed. Doubtless a few more white men live at other trading posts farther east, but the total white population of the district is very small.

The native population consists of Crees and Ojibways, who are scattered here and there over the whole country, mostly on the banks of lakes and streams where a supply of fish can be depended on for food, and where fur-bearing animals can be caught, with the skins of which they may purchase ammunition, implements, clothing and such articles of white man's food as they may consider necessary.

In several places little groups of houses were seen in which the Indians pass the winter, and we were told of other groups of houses off our line of travel. When we passed them the houses were not occupied, and the Indians were away hunting or fishing elsewhere.

The people seemed to be generally healthy and comfortable. With the exception of a few coats and blankets or rabbit skin, they dress entirely in clothing obtained from the traders. The total Indian population of the district, as given me by Mr. D. C. Scott, Secretary of the Department of Indian Affairs for Canada, is as follows:—

Indians receiving pay from the Government under Treaty:—

Osnaburg	290	
Fort Hope	479	
Martin's Falls	99	
Fort Albany	741	
		1,609

Indians estimated:—

Fort Severn	250	
Trout Lake	500	
Winisk River	250	
Attawapiskat	150	
Sandy Bay	100	
Cat Lake	150	
		1,400
Total		3,009

Photo by J. B. Tyrrell, Oct. 13, 1912.
Woods on the portage past Pesew falls, just north of Cat lake. An Indian letter on the tree in the centre.

Photo by P. E. Hopkins, Oct. 2, 1912
Indians on the bank of Ningitowa river. The boy sitting on the canoe is dressed in a coat of rabbit-skin.

Animals

Animals did not seem to be particularly plentiful anywhere throughout the district.

Polar bears (*Thelassarctos maritimus*) are occasionally found on or near the coast of Hudson Bay.

Black bears (*Ursus americanus*) roam through the forest almost everywhere.

Photo by P. E. Hopkins, Oct. 11, 1912.
Indian letter on portage on Severn river. "It was morning when the white chief passed very near the freeze up."

Barren Ground caribou (*Rangifer arcticus*) appear to regularly frequent the open country along the shore near and to the west of Goose river during the summer, turning inland in a westerly direction on the approach of autumn, whence they are said to go westward to spend the winter in the vicinity of Split lake, returning eastward again to the coast in the following spring.

The annual migration of this herd of caribou has often been observed. In May, 1792, David Thompson speaks of watching a vast herd cross the Hayes river in an easterly direction about twenty miles above York Factory. It took two days to cross the river, and he estimated that it included several million individuals. At the present time, it is said that the herd usually crosses the lower portion of the Shamattawa river on its way inland in the autumn.

Woodland caribou (*Rangifer caribou*) are found scattered in small numbers throughout the district.

Moose (*Alces americanus*) are fairly abundant throughout the district as far north as Trout lake, and a few are occasionally met with to within 75 miles of Hudson Bay.

Virginia deer (*Odocoileus virginianus*) are occasionally killed near Lake St. Joseph, but they do not occur much farther north.

Photo by P. E. Hopkins, Sept. 24, 1912.
Rev. Mr. Dick with his pet black fox at Trout lake.

Of the smaller fur-bearing animals, the following are the most abundant, and the trade in them has constituted the chief industry of the country up to the present time: Black, cross and red foxes (*Vulpes vulgaris*), lynx (*Lynx canadensis*), Otter (*lutra canadensis*), marten (*Mustela americana*), Mink (*Putorius vison*), Weasel (*Putorius vulgaris*), Skunk (*Mephitis mephitica*), Beaver (*Castor fiber*), and Muskrat (*Fiber zibethicus*).

Waterfowl are not very abundant, except on the coast of Hudson Bay, but a few ducks breed on the rivers and lakes, and geese fly over the country in considerable numbers during their spring and autumn migrations.

Both the ruffed grouse and the spruce grouse (*Bonasa umbellus* and *Canachites canadensis*) were found everywhere in the woods throughout the district, though nowhere in great abundance. The sharp-tailed grouse (*Pedioecetes phasianellus*) seemed to be fairly abundant near Makoop Lake, and the willow ptarmigan (*Lagopus lagopus*) was found in the open country near the shore of Hudson Bay.

Fish form the staple food of the inhabitants of this country. The principal kinds so used are trout, whitefish, tullibee and suckers.

Photo by J. B. Tyrrell, Oct. 2, 1912.
Clay plain beside Ningitowa river.

Minerals

No minerals of economic importance have yet been recorded from the vicinity of the route travelled over last summer, but there is little doubt that fuller investigation will determine their existence.

Several areas of greenstone and other similar rocks of Keewatin age were crossed, especially on Trout, Windigo and St. Joseph lakes. Wherever rock of similar age and character to these have been thoroughly prospected in other parts of Canada, valuable minerals, usually including the precious metals, have been found in them, and there is no reason to suppose that the areas of Keewatin rocks here recorded will form exceptions to this rule. The Palæozoic limestone near the shore of Hudson Bay may also contain beds of salt, gypsum or other valuable minerals of similar character.

Agriculture

In other parts of this report, and especially under the description of the geological features of the country, I have shown that there is an enormous area consisting of fifty or sixty thousand square miles of country underlain by glacial clays, or marine clays and sand, and that also north of the highest part of the land, there is a large additional area of unknown extent covered with loose glacial detritus of varying composition. Most of this country is now wet and undrained, and has a particularly uninviting and repellant appearance. However, much of it has a sufficient slope to permit of drainage, and as the clays themselves possess those qualities which should make rich fertile soil, the agricultural possibilities of the country are limited only by the climate, of which but little is yet known.

During the past summer, Mr. Moir, of the Hudson's Bay Company, and the Rev. Mr. Dick, the missionary, raised excellent crops of potatoes at Trout Lake on small patches of ground, and Indians also had good fields of potatoes at a number of other places in the district. Some years ago, the officer then in charge of the trading post at Trout lake for the Hudson's Bay Company kept cattle, and cultivated all the ordinary garden vegetables commonly raised in Manitoba, but the cattle were ordered to be killed, and all cultivation, except that of potatoes, was discontinued, for these grow freely, with very little expense for care and attention. I strongly recommend that suitable steps be taken to ensure the establishment of an experimental farm or garden at Trout lake, either with the co-operation of the Department of Agriculture of the Dominion of Canada, or by the Government of the Province of Ontario itself.

Photo by H. C. Moir, Hudson Bay Co.
Digging the garden at Trout lake.

Rivers Flowing Into Hudson Bay

The principal rivers flowing into the west coast of Hudson Bay, beginning at the north and proceeding southward, are:—

	Length.
Dubawnt with Chesterfield Inlet	900 miles
Kazan	500 "
Thlewiaza	300 "
Seal	250 "
Churchill	1,000 "
Nelson—Saskatchewan	1,700 "
Hayes	320 "
Severn	420 "
Wenisk	400 "
Attawapiskat	465 "
Albany	610 "
Moose	340 "

The exploration of the past summer had to do with only three of these rivers, namely, the Nelson, Hayes, and Severn, and, consequently, the remarks here made will be confined almost exclusively to these three streams.

As will be explained later, the land around Hudson Bay was formerly, relatively to sea level, depressed about 400 or 500 feet lower than it is now, and consequently the water covered much of what is now land, and the area of the Bay was considerably greater than it is at present.

On the western shore of the Bay, the land, even when the water stood at its highest level, sloped gently downwards into the sea, and erosion cliffs, marking old strand lines, are conspicuously absent. This feature is equally prominent on the present shore, for the land now rises very gradually back from the gravel beaches which form the confines of the water area of the Bay. From Eskimo Point, in north latitude 61° 04′, down the coast all the way to the mouth of the Moose river, there does not appear to be a single wave-cut cliff facing the ocean.

Photo by J. B. Tyrrell, July 12, 1912.
Tidal shore on west side of Hayes river, a short distance below York Factory.

The three rivers last mentioned flow down this gentle regular slope, and at and near their mouths have cut gorgelike valleys into the marine and glacial clays sometimes down to the underlying hard rock. All have many features in common.

The Severn

The Severn river, below Limestone rapids, where it has last cut down to the underlying rock, has a very juvenile character. Its banks are steep and often precipitous, with glacial clays at the bottom and marine clays above. Nearer the mouth the glacial clays disappear, and stratified clays and sands form the whole thickness of the sediments exposed in the banks. In places its channel is broken by islands, those higher up the stream being for the most part fragments cut off from the adjoining country as the river deepened its channel, while those nearer the mouth on the contrary have either been partly built up by sediments brought down by the current, or represent the old bed of the river past which the stream has cut new channels in comparatively recent times.

The Hayes

The Hayes river is similar in character to the Severn. Both are from half a mile to a mile in width ten miles above their mouths, with currents of about three miles an hour, the low islands within the tidal portion of the Hayes river being if anything more conspicuous than in the Severn. In both cases the rivers themselves are now cutting away the steep banks on their western sides, and are building low flats on their eastern sides.

Two opportunities presented themselves of measuring the rate at which the latter river cuts away its banks. In the year 1900 the Hudson's Bay Company had a reserve

Photo by J. B. Tyrrell, July 13, 1912.
Site of old York Factory on the bank of Hayes river, about half a mile below the present fort. On the left of the picture is a cellar of one of the old houses, with some of the timbers which covered it.

surveyed around York Factory, and posts were planted at the north and south ends of this reserve close to the top of the bank, or rather 75 and 20 feet respectively from it. The post at the north end is now 35 feet from the top of the bank, 40 feet having been washed away in twelve years, and the post at the south end has been washed away entirely, and a measurement from the southwestern corner of the reserve shows that about 35 feet of the bank has been carried away. These measurements would indicate that the river was cutting away its west bank at the rate of about three feet in a year.

Half a mile north of the site of the present York Factory is the site of old York Factory, from which the trading post of the Hudson's Bay Company was removed in

1789. Fortunately, we have a survey of this site made by Joseph Robson in 1745, which shows a little stream with four bends within or close to the stockades of the Fort. These bends of the stream provide an excellent measure for determining the former position of this Fort and of the shore line in front of it. Two of the bends have already disappeared, having been washed away by the stream, the other two being quite recognizable by a comparison of the old plan and one made at the présent time. These two plans show distinctly that the bank has been cut back a distance of 168 feet since Robson's plan was made one hundred and sixty-seven years ago, or a recession of practically one foot a year in that time.

Another point of great interest is shown by the site of this old Fort. The line of the bank now cuts through a cellar which was evidently under one of the old houses at the Fort before it was destroyed by the French in 1782, and this cellar is now just at the top of high tide. As it is not likely that it was dug below high tide level, where it would have been subject to constant floods, it furnishes corroborative evidence to that which I obtained at Churchill in 1893 and 1894 that the land around Hudson Bay has reached a condition of stability.

Similar evidence of the present stability of the land is furnished by the existence of trees more than one hundred years old close to tide water on the banks of the Nelson river, and the strength of the beaches of sand and gravel which in many places form the present shore of the Bay would also indicate stability of the land for a moderate length of time to enable such strong beaches to be formed.

While it is evident, therefore, that the land on the shore of the Bay has now ceased to rise, it is equally evident from the character of the clay-covered plain around Hudson Bay, and the newness of the raised beaches on that plain, that it has risen several hundred feet within geologically recent times.

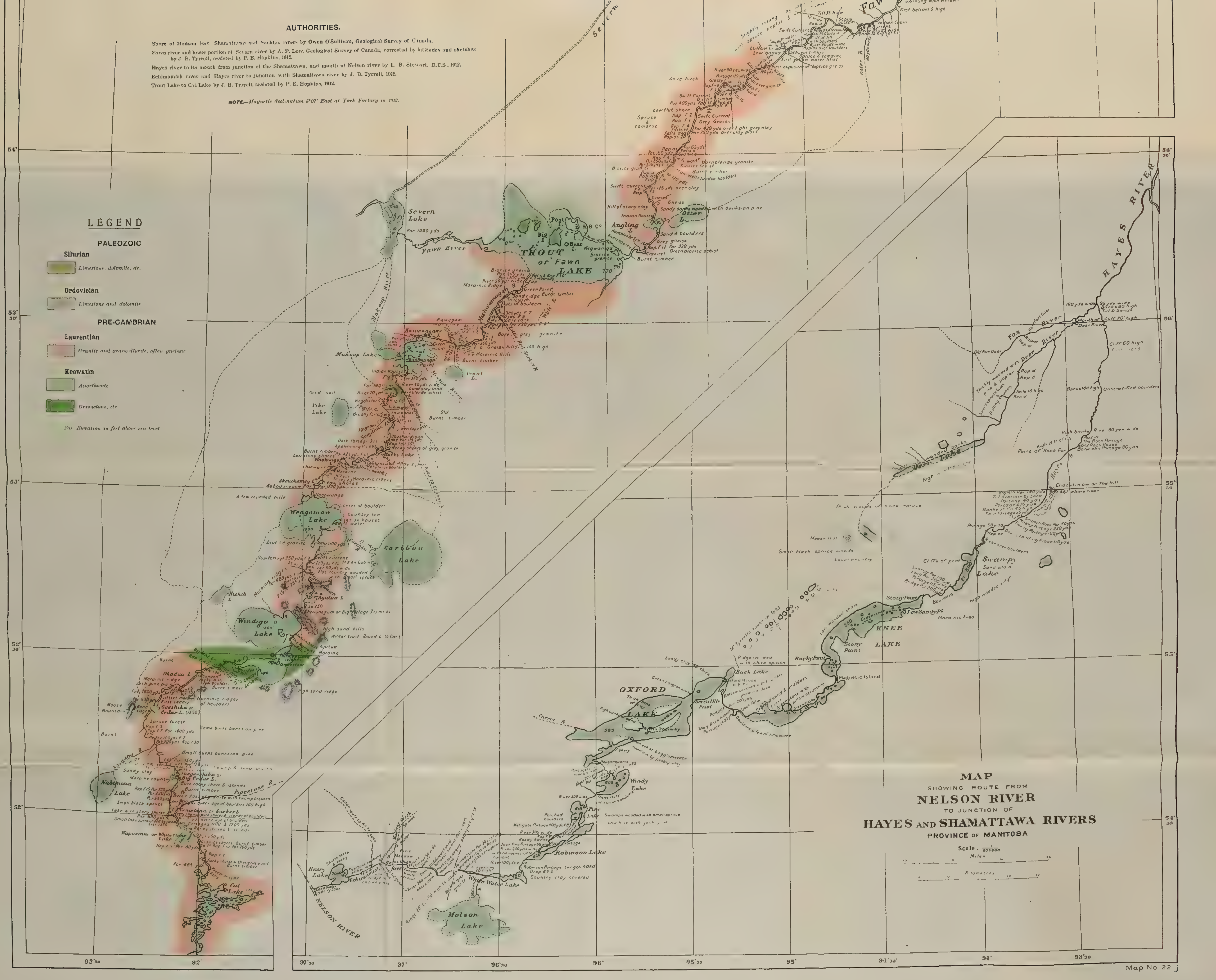
The Nelson

The Nelson river differs somewhat from the two rivers of which we have just spoken. Like them, and in fact like all the rivers flowing into Hudson Bay, it is cutting into the cliffs on its west bank, but unlike the Hayes and Severn rivers, these cliffs are of glacial till and not of marine sediments, and the bed of the river to its mouth is composed of similar hard till or hardpan, into which the river is actively cutting its channel. As the river is everywhere cutting down and deepening its channel, it is not now building up islands like those near the mouth of the Hayes river, but is carrying all the sediment derived from the bottom of the channel and from the bank on its western side down into the Bay. The two islands in the upper portion of the mouth of the river, namely, Seal and Gillam islands, are fragments cut off from the surrounding country by diversion of the channel, and have not been built up by the river itself.

The stream fills the lower portion of the valley of Nelson river from side to side. In places terraces may be seen at the mouths of tributary streams, such as at the mouth of the Seal river, a small tributary from the south, but if any terraces have existed in the main valley itself they have been swept away. The river has all the appearance of having originally been cut out by a smaller stream, probably the lower continuation of the Burntwood river, which drains a considerable portion of the country between the Saskatchewan and Churchill rivers. Afterwards a larger stream was introduced into it, and this stream is now actively widening and deepening the old valley, forming precipitous cliffs on one or both sides.

The facts that the stream is flowing over a bed of boulder-clay into which it is actively cutting its channel, and that it is not filling up its bed at its mouth, are of great importance in the consideration of any harbour improvements that may be made in it, for this boulder-clay, which however contains few boulders, can be readily dredged, and at the same time the dredged areas, if arranged so that they may be scoured out by the current, will have no tendency to fill up, and the excavated channels will remain as permanent improvements, much the same as if they had been excavated in solid rock.


HUDSON BAY
NELSON RIVER
YORK FACTORY (H. B. Co)
HAYES RIVER
FORT SEVERN (H. B. Co)
Partridge Island
SEVERN RIVER
Cape Tatnam
MANITOBA
ONTARIO
INTERPROVINCIAL BOUNDARY
Machichi River
Broad River
Kaskattamagan River
Black Duck River
Black Currant River
Beaver River
Beaverstone River
Sachigo River
Sturgeon Lake
Shamattawa River
Niskibi or Goose Lake
Head Id
Pig Id
Wapatinow L.
Fawn River
ONTARIO DEPARTMENT OF LANDS, FORESTS AND MINES
BUREAU OF MINES
MAP
SHEWING ROUTE OF THE
NELSON RIVER EXPLORING EXPEDITION
THROUGH THE
PROVINCES OF MANITOBA AND ONTARIO
To accompany report by J.B. TYRRELL
Part 1, Vol. 22, Report of Bureau of Mines, 1913
Hon. W. H. Hearst, Minister
Scale: 1/633,600 or 10 Miles = 1 Inch
Miles
Kilometres


AUTHORITIES.
Shore of Hudson Bay, Shamattawa and Sachigo rivers by Owen O'Sullivan, Geological Survey of Canada.
Fawn river and lower portion of Severn river by A. P. Low, Geological Survey of Canada, corrected by latitudes and sketches by J. B. Tyrrell, assisted by P. E. Hopkins, 1912.
Hayes river to its mouth from junction of the Shamattawa, and mouth of Nelson river by L. B. Stewart, D.L.S., 1912.
Echimamish river and Hayes river to junction with Shamattawa river by J. B. Tyrrell, 1912.
Trout Lake to Cat Lake by J. B. Tyrrell, assisted by P. E. Hopkins, 1912.
NOTE.—Magnetic declination 5°07' East at York Factory in 1912.
LEGEND
PALEOZOIC
Silurian
Limestone, dolomite, etc.
Ordovician
Limestone and dolomite
PRE-CAMBRIAN
Laurentian
Granite and grano diorite, often gneissic
Keewatin
Anorthosite
Greenstone, etc
770 Elevation in feet above sea level
MAP
SHOWING ROUTE FROM
NELSON RIVER
TO JUNCTION OF
HAYES AND SHAMATTAWA RIVERS
PROVINCE OF MANITOBA
Scale
Miles
Kilometres
Map No 22 J
HAYES RIVER
Severn Lake
Fawn River
TROUT or Fawn LAKE
Angling L.
Otter L.
Makoop Lake
Pike Lake
Weagamow Lake
Caribou Lake
Windigo Lake
Okadua L.
Nabimina Lake
Cat Lake
OXFORD LAKE
KNEE LAKE
Swampy Lake
Back Lake
Windy Lake
Robinson Lake
White Water Lake
Molson Lake
Hairy Lake
NELSON RIVER
Fox River
Deer River
Pipestone R.
Severn
54°
53° 30'
53°
52° 30'
52°
56°
55° 30'
55°
54° 30'
92° 30'
92°
97° 30'
97°
96° 30'
96°
95° 30'
95°
94° 30'
94°
93° 30'

In this connection it may be noticed that the Nelson river above the influence of high tide is practicaly a river of clear water, carrying very little sediment, and the mud which is held in suspension by the water in the mouth of the river is derived largely from the bottom of the river itself or from the clay cliffs which form its banks. If these cliffs are protected from denudation, and if the river below Seal island is diked into a channel of even width, so that the water will not spread out over the shallow clay flats on both sides, the water would probably be clear where it flows into the Bay, and there would be no trouble whatever in keeping a channel open out into the deeper water of the Bay. Such dykes as I have spoken of could be built by the dredge which was digging the channel, and they would prevent the incoming tide from spreading out over a very large area, and would consequently decrease the tremendous current which is now caused at the mouth of the river by both the flowing and the ebbing tide.

It is thus seen that the Nelson river differs materially from the other rivers flowing into Hudson Bay, and this difference is doubtless caused by the fact that the large stream draining Lake Winnipeg took possession of the lower portion of the smaller valley, probably of Burntwood river, in very recent times, and is now actually widening and deepening this older and smaller valley.

Photo by J. B. Tyrrell, July 25, 1912.

Shore on the east side of Nelson river at low tide. Boulders are lying on a hard till.

Geology

The rocks met with during the summer may be considered under the following heads in ascending order:—

Archæan.—Composed of granites, gneisses, greenstones, gabbros, anorthosites, and other igneous or highly altered sedimentary rocks such as are found almost everywhere throughout northern Canada.

It is probable that all these rocks should be included in either the Keewatin or the Laurentian series.

Palæozoic.—Ordovician and Silurian limestones and dolomites, mostly flat-lying. They overlie the Archæan Complex and extend southward from the south shore of Hudson Bay for a distance of sixty miles or more.

Pleistocene deposits, consisting of tills and glacial and inter-glacial clays and sands, with occasional beds of peat or lignite.

Recent deposits, composed of clays and sands laid down at or near the mouths of the rivers on Hudson Bay, and marine clays and sands, which extend inland from the Bay for varying distances up to about one hundred and fifty miles. The sands in many cases represent old shore lines. Besides these, the recent deposits include beds laid down in fresh water lakes and in the bottoms of the valleys of existing streams.

Archæan

The Archæan rocks outcropping in the country northward from Sioux Lookout on the Grand Trunk Pacific railway to Cat lake have been described by Dr. A. W. G. Wilson in a report to the Geological Survey of Canada, and as my observations added very little new information to that collected by Dr. Wilson, it is unnecessary for me to repeat here what he has already said, more especially as the rocks are mostly granites and gneisses, such as are commonly found in many parts of northern Canada and are usually classed as of Laurentian age, though associated with them are a few narrow bands of greenstones and amphibolites, some of which may be of Keewatin age.

Laurentian

Laurentian rocks, similar to those on Cat lake and river, were also found along the canoe route northward from Cat lake through Whitestone lake, across the height of land, down the Cedar branch of the Severn river to Cedar lake, and thence northeastward to the vicinity of Windigo lake.

On Windigo lake, rocks of Keewatin age were encountered, but these are described more in detail below. From Windigo lake northward through Weagamow and Makoop lakes, similar Laurentian rocks occur all the way to Trout lake, the south shore of which is formed of a rather prominent granite ridge. On Trout lake another belt of Keewatin rock occurs. On the northern side of this lake, Laurentian granites and gneisses again make their appearance and outcrop for a distance of sixty-one miles down the Fawn river, when they finally disappear under an overburden of surface clays and sands.

These Laurentian rocks are all of very similar character throughout, and the following descriptions by Mr. Ellis Thomson of specimens collected at various places along our line of travel will give a fair idea of their general character.

Portage 42, Windigo river.—A gneissoid rock of fairly fine grain, composed chiefly of quartz, orthoclase, microcline, biotite, and muscovite, but containing also considerable quantities of plagioclase, chlorite, and epidote. Apatite and magnetite are prominent accessory constituents the latter altered in places to limonite. It is a typical two-mica gneiss of fairly fine texture.

Mouth of Mishwamagan river.—A granitoid rock of gneissoid structure, composed for the most part of quartz, orthoclase, microcline, and biotite. Considerable plagioclase is also present. Apatite, magnetite, and limonite are more or less important accessory constituents, the first-named being quite prominent. Considerable of the biotite has been altered in places to epidote. It seems to be a biotite gneiss of medium grain, although scarcely schistose enough to be quite typical.

Trout lake at head of Fawn river.—A granitic rock, composed chiefly of quartz, orthoclase, biotite, and green hornblende in about equal amounts. Microcline and plagioclase are other feldspars present. Apatite, magnetite, and pyrite are all fairly common accessory constituents, while there are considerable quantities of chlorite and epidote present as alteration products of the hornblende and biotite. It may best be described as a hornblende-biotite granite.

Lowest granite outcrop on Fawn river.—A granitic rock of gneissoid structure composed chiefly of microcline, quartz, and biotite. Orthoclase and plagioclase are also present in subordinate quantities, while apatite and magnetite are prominent accessory constituents, the former as short stout crystals. A little muscovite is also present, and both the micas have been altered in places to chlorite and epidote. The quartz and the feldspar show a graphic intergrowth in some places. This specimen gives a beautiful illustration of the gridiron structure in the microcline.

Portage 20, Negigamo river.—A very schistose rock, consisting almost entirely of green hornblende and quartz grains. Magnetite is a rare constituent. The hornblende is slightly altered in places to chlorite. A typical hornblende schist.

Keewatin

Two important bands of rocks of this series were encountered during the summer within the district of Patricia, one at Windigo lake and the other at Trout lake. It is possible that other narrow bands of similar rock may have been crossed along the line of travel, but if so they were hidden by the overburden of sand and clay, and it was impossible to see them.

In the southern expansion of Windigo lake, green gabbros and diabases were seen in a number of places along our course. As a rule, they did not appear to have any very definite dip or strike, and no quartzites, conglomerates, or other clastic rocks were found associated with them.

Photo by J. B. Tyrrell, Sept. 24, 1912.
Shore of Big island in Trout lake, showing the greenstone rock with two sets of glacial markings running respectively North 40° West, and South 40° West.

The following descriptions of specimens taken from two places at which we stopped will give a good general idea of the character of the whole.

Island in Windigo lake.—A very much altered rock with ophitic structure, consisting for the most part of fine laths of plagioclase, shreds of chlorite, and grains of epidote, calcite, and magnetite. Pyrite is also present in small amounts. The calcite seems to be present in the form of little vein-like fillings.

Point on Windigo lake.—A fairly coarse-grained rock consisting of needles of plagioclase (labradorite?) and green hornblende, the latter very largely altered to chlorite. Considerable epidote and ilmenite are also present, the latter altered in places to leucoxene. Pyrite is a rare constituent. This rock appears to come in the diorite class, but shows the ophitic structure very plainly.

Trout lake occupies a basin excavated in green Keewatin schists and diabases north of a prominent granite ridge which now forms its southern boundary, and the many islands which rise above the surface of the water are mostly rounded glaciated knolls of greenstone. The time at our disposal did not permit us to examine any of these, except such as lay directly on our course. However, the following descriptions of specimens collected from Big island and another island two miles to the southwest of it will give a clear idea of the character of the rock. In most places it shows the typical pillow structure characteristic of many of the Keewatin greenstones throughout northern Canada.

Big Island, Trout lake.—A very much altered rock of diabasic texture. It consists for the most part of laths of plagioclase with an ophitic arrangement, and green hornblende. The latter mineral has quite evidently been derived by a uralitization process from augite. The unaltered pyroxene still remains in several places, but is mostly altered at the edges to hornblende. Ilmenite and pyrite are two fairly prominent metallic constituents, the former being altered in a great many places to leucoxene. The hornblende is also altered in several places to chlorite. This rock seems to represent an intermediate type between the epidiorites and the true diorites, being probably closer to the diorite division. The ophitic structure of the original rock is still in evidence, proving that the rock was formerly a diabase.

Island 2 miles southwest of Big island, Trout lake.—A very much altered rock consisting chiefly of epidote, calcite, chlorite, and kaolinized material. Small quantities of magnetite and quartz are also to be found. This may best be described as an epidote rock, the alteration having gone so far that no conjecture can be made as to its original identity.

To the north of the greenstones, near the north shore of Trout lake, are a number of outcrops of a massive intrusive anorthosite, which is possibly of Keewatin age, though it may be newer. This rock has a coarse porphyritic and granitoid structure and forms a conspicuous feature on the shore. The following descriptions of thin sections which were examined under the microscope by Mr. Thomson will give a good idea of its general character.

Island, mouth of Fawn River.—A feldspar rock consisting chiefly of plagioclase (labradorite and bytownite), but containing considerable quantities of chlorite and epidote as well. Hornblende, magnetite, and limonite are also found in small quantities. It appears to be a typical anorthosite somewhat weathered.

Fort Island, Trout lake.—A feldspar rock consisting almost entirely of plagioclase, but containing some epidote as well as a little chlorite, magnetite, and limonite. It seems to be a typical anorthosite.

Island, 4 miles east of Fort island, Trout lake.—A feldspar rock consisting almost entirely of plagioclase (labradorite) and epidote. Considerable chlorite appears also, as well as a little magnetite and limonite. It appears to be a typical anorthosite, considerably weathered.

Northwest end Fort island, Trout lake.—This rock consists for the most part of plagioclase (labradorite), green hornblende, and magnetite. A good deal of the hornblende has altered to chlorite and epidote. Quartz and pyrite are rare constituents. It seems to be a typical diorite, slightly altered.

Palæozoic

Ordvician

In descending the Fawn branch of the Severn river, the last Archæan rocks seen in the bed of the stream are at a distance of about one hundred and sixty-five miles from the shore of Hudson Bay measured in a straight line, and from there northward for about one hundred miles, no hard rocks of any kind in place are to be seen. Then limestones of about the age of the Guelph formation in Ontario make their appearance. No older rocks of Ordovician or Silurian age were found on this river, but away to the northwest about two hundred miles distant, on a branch of the Hayes river called the Shamattawa river, there is a long exposure of limestone in the form of low cliffs extending for several miles beside the banks of the stream. The limestone is thin-bedded and lies in a horizontal attitude and is usually mottled, very much like that at East Selkirk in Manitoba. The total thickness exposed is about twenty-five or thirty feet.

From this exposure, and from the talus of broken fragments on the bank at the foot of the cliffs a number of fossils were collected, among which were the following:—

Columnaria rugosa, Billings;
Streptelasma corniculum, Hall;
Favosites aspera, d'Orbigny;
Tetradium fibratum, Safford;
Strophomena julia, ? Billings;
Rafinesquina lata, Whiteaves;
Rhynchotrema capax, Conrad;
Dinorthis pectinella, Emmons;
Maclurina manitobensis, Whiteaves, var. *acuta;*
Maclurea subovata, n. sp.
Trochonema umbilicatum, Hall;

Photo by J. B. Tyrrell, June 28, 1912.
Talus of Ordovician limestone on the north bank of the Shamattawa river.

Hormotoma sp.
Holopea sp.
Orthoceras sp.
Orthoceras lepidodendroides, n. sp.
Actinoceras bigsbyi, ? Stokes;
Actinoceras richardsoni, Stokes; var. magnum, n. var.;
Actinoceras sp.
Cyrtoceras manitobense, ? Whiteaves;
Poterioceras tyrrelli, n. sp.;
Ascoceras boreale, n. sp.;
Trochoceras insigne, Whiteaves;
Spyroceras meridionale, ? Whiteaves;
Illaenus americanus, Billings;

Professor W. A. Parks, University of Toronto, gives the following notes and descriptions of the species here enumerated:—

CORALS:—

Columnaria rugosa, Billings.—One good specimen in a soft calcareo-argillaceous matrix.

Streptelasma corniculum, Hall.—Five incomplete specimens which are probably referable to this species as defined by Lambe.

Favosites aspera, d'Orbigny.—Two coralla, each about four inches in diameter. The corallites are of nearly equal size in the individual specimen, but in one example they average about 1.5 mm. and in the other 2.5 mm. in diameter. The tabulae are complete and closely set: in the coarser form they are about 1 mm. apart, and in the finer example, five occur in the space of 3 mm. The specimens do not reveal the slightest trace of septal spines or mural pores. In *F. aspera* the pores are situated at the angles of the corallites; unless these structures can be made out, the reference of the form to the present species is doubtful. It would seem that we are dealing with the same form referred to by Lambe in the following words. "Specimens of a *Favosites* have also been collected at East Selkirk and Lower Fort Garry, Manitoba, that are doubtfully referred to this species; they do not show the mural pores although otherwise the structure is well preserved. The rocks at this locality have been referred by Mr. Whiteaves to the Galena-Trenton, so that if through the medium of other specimens from these places the pores are found to be situated at the angles of the corallites, the downward extension of the range of *Favosites aspera* will be considerable."

Tetradium fibratum, Safford.—One specimen showing clearly the structure of the species.

BRACHIOPODS:—

Strophomena cf. julia, Billings.—Four casts of a strophomenoid form which closely resembles Billings' species in the possession of widely spaced major striae radiating from the beak. Compare also *Leptaena unicostata*, Meek and Worthen.

Rafinesquina lata, Whiteaves.—A fragment of a single valve which is probably referable to this species.

Rhynchotrema capax, Conrad.—A single worn and partly decorticated valve of doubtful identification.

Dinorthis pectinella, Emmons.—Three decorticated specimens referable to this species or possibly to *D. subquadrata*, Hall.

GASTROPODS:—

Maclurina manitobensis, Whiteaves, var. *acuta*, var. nov.—One cast of the interior with a small portion of the shell adhering on the convex side and with nearly the whole of the test on the flat side preserved. The shell is 95 mm. in diameter and the height of the outer volution is 35 mm. In form, the specimen conforms closely to Whiteaves' description, but the characteristic lines of growth and surface ornamentation are wanting. The flat side is slightly depressed in the middle. The peripheral angle is acute and is accentuated by a slight depression just above the margin on the convex side.

Maclurea subovata, sp. nov.—One good cast of the interior and several fragments. The maximum diameter is 63 mm. and the height of the outer volution 33 mm. The form resembles *M. bigsbyi* but it differs in that the "flat" side of the outer volution is quite convex; the amount of the convexity being one-fifth the width of the whorl. This feature gives a subovate rather than a trapezoidal outline to the cross section.

Trochonema umbilicatum, Hall.—Seven specimens, all casts of the interiors.

Hormotoma, sp.—Two casts with a portion of the test indifferently preserved. Apical angle more acute than in *H. trentonensis*. This form must be compared with *H. arctica*, Ami, which is listed as a new species but without description in "The Cruise of the Neptune."

Holopea, sp.—One cast of the interior of a large specimen, 40 mm. wide by 30 mm. high. The specimen must be compared with *H. borealis*, Ami, listed without description in "The Cruise of the Neptune."

CEPHALOPODS:—

Orthoceras, sp. indet.—One badly preserved cast of the chamber of habitation. Cross section oval, diameter 21 by 17 mm. Siphuncle small, central.

Orthoceras lepidodendroides, sp. nov.—One cast of the interior, showing portions of 8 camerae. Cross section ovate, 60 mm. by 30 mm., but the form is probably crushed. The whole surface is marked by distinct blunt nodes arranged in a quincuncial manner which gives the cast the appearance of a *Lepidodendron*. Siphuncle not observed. The surface ornamentation is very characteristic and is sufficient for the identification of the species.

Actinoceras cf. bigsbyi, Stokes.—Two badly preserved specimens with large nummuloid siphuncles which agree in shape and spacing with this species. The siphuncle is marginal and occupies fully two-thirds of the air chambers.

Actinoceras richardsoni, Stokes, var. *magnum*, var. nov.—One cast of the interior with septa and siphuncle preserved. If the shell is round the diameter cannot be less than six inches and is probably greater. The siphuncular annulations are 25 mm. in diameter, evenly rounded, and occur to the number of 12 in a length of 205 mm. A large endosiphuncle is observable having a diameter of 14 mm. The siphuncle is eccentric in position. This form agrees fairly well with *A. richardsoni*, but differs in the larger size of the shell and in the relatively smaller siphuncle.

Actinoceras, sp. indet.—One badly preserved siphuncle embedded in matrix. The specimen undoubtedly represents a different species, as the siphuncular beads are expanded anteriorly and are as much as 23 mm. apart. The form represents a transition to the genus *Huronia*.

Cyrtoceras cf. manitobense, Whiteaves.—Three fragments which are doubtfully referred to this species. The general size of the forms, the spacing of the septa and the position of the siphuncle agree fairly well, but the curvature of the septa is much less pronounced.

Photo by J. B. Tyrrell, Sept. 9, 1912.

Cliff of Silurian limestone at Assina rapid, Severn river.

Poterioceras tyrrelli, sp. nov.—Two well preserved casts of the interior, showing the characteristics of the chamber of habitation and of nine air chambers. The smaller and more perfect specimen gives the following measurements:

Maximum width at second septum, dorso-ventral, 48 mm.; lateral, 37 mm.
Width at ninth septum, dorso-ventral, 35 mm.; lateral, 30 mm.
Length of body chamber, 38 mm.
Diameter of orifice, dorso-ventral, 37 mm.; lateral, 22 mm.
Average spacing of septa, 3.5 mm.

The siphuncle is small and marginal in position. The body chamber contracts towards the mouth as shown by the above figures, but there is a sharp outward inflection of the shell at the aperture. On the posterior margin of the body chamber, the cast shows a ring of bead-like markings which occupy a space comparable with that of one air chamber. A photograph taken by Mr. Tyrrell of a specimen which he was unable to obtain shows this peculiar feature in a better manner than either of the specimens in hand.

Ascoceras boreale, sp. nov.—One cast of the interior; septa not preserved. This form differs in the curvature of the septal markings and in its general shape from *A. costulatum*, Whiteaves, and *A. canadense*, Billings.

Trochoceras insigne, Whiteaves.—A portion of a mould of the exterior. Whiteaves' only figure is of a cast of the interior, but there can be little doubt of the identification of the present example.

Spyroceras meridionale, ??? Whiteaves.—A small portion of a cast very doubtfully referred to this species.

TRILOBITES:—

Illaenus americanus, Billings.

These fossils would indicate that the rock is about the age of the top of the Trenton of Eastern Canada.

While there is no certainty that rocks of Trenton age occur as far eastward as the Severn river, it would seem not improbable that they may exist beneath the drift in the portion of the country where no exposures have been observed.

Silurian

As stated above, limestones which appear to be of about the age of the Guelph of eastern Canada, outcrop on the Fawn river at a distance of about sixty-five miles in a direct line southwestward from Hudson Bay, and continue to be exposed for a distance of fifty miles down the Fawn and Severn rivers to what is known as the Limestone rapids on the latter stream twenty-eight miles from the Bay. These rocks vary from thin-bedded limestones to thick-bedded Stromatoporoid dolomites, and while they most usually occur in the bed of the stream they often form low cliffs along its side. In the majority of exposures the limestone is horizontal, but at Limestone rapids of the Severn river it is undulating, a thin-bedded limestone rising over knolls of more massive dolomite.

Fossils are not abundant in many places, and even where found are often difficult to extract from the rock in a sufficiently perfect condition for identification, but, nevertheless the following species were collected at the various rock exposures on the Severn and Fawn rivers, all of which are of about the same geological horizon. The collection was made without delaying the survey or rate of travel, and mostly during a day when we were obliged to remain in camp by a heavy storm of wind and rain.

Actinostroma tenuifilum, Parks;
Favosites gothlandica, Lamarck;
Favosites hisingeri, Milne-Edwards & Haime;
Halysites catenulatus, Linnaeus;
Pycnostylus guelphensis, Whiteaves;
Zaphrentis stokesi, Milne-Edwards & Haime;
Streptelasma sp.;
Petraia ? occidentalis, Whiteaves;
Acervularia austini, Salter;
Aphyllostylus gracilis, Whiteaves;
Tyrrellia severnensis n. sp.;
Fenestella subarctica, Whiteaves;
Rhynchospira lowi, Whiteaves;
Hormotoma patriciaense, n. sp.;
Hormotoma whiteavesii, Clarke and Ruedemann;
Pentamerus oblongus, Sowerby;
Trimerella ekwanensis, Whiteaves;
Glassia variabilis, Whiteaves;
Spirifer crispus, Hisinger;
Delthyris sulcata, Hisinger;
Reticularia septentrionalis, Whiteaves;
Gypidula, sp.;
Stropheodonta, sp.;
Camarotoechia ekwanensis, Whiteaves;
Plectambonites transversalis, Wahlenberg;

Meristina expansa, Whiteaves;
Bellerophon sp.;
Megalomphala robusta, Whiteaves;
Strophostylus filicinctus, Whiteaves;
Trepospira kokeni, Lindstrom;
Gyronema hudsonica, n. sp.;
Gyronema dowlingii, Whiteaves;
Gyronema speciosum, Whiteaves;
Coelocaulus macrospira, ? Hall;
Clathrospira sp.;
Eotomaria sp.;
Euomphalopterus tyrrelli, n. sp.;
Euomphalopterus sp.;
Euomphalopterus valeria, Billings;
Trochus, ? sp.
Lophospira, ? sp.;
Liospira, ? sp.;
Diaphorostoma perforatum, ? Whiteaves;
Pterinea, sp.;
Modiomorpha acuminata, n. sp.;
Orthoceras, sp.;
Gomphoceras, sp.;
Phragmoceras Whitneyi, n. sp.;
Phragmoceras lineolatum, Whiteaves;
Phragmoceras, sp.;
Cyrtoceras, n. sp.;
Barrandeoceras, ? sp.;
Endoceras hudsonicum, n. sp.;
Actinoceras hearsti, n. sp.;
Actinoceras, n. sp.;
Illaenus ioxus, Hall;
Encrinurus arcticus, ? Salter.

The short time at my disposal and the inability to carry a heavy load of specimens up the Fawn river and over the height of land to the head waters of the Albany and Winnipeg rivers so late in the season prevented me from collecting and bringing to Toronto as good and full a series of fossils from those Silurian limestones as I could have wished.

Professor Parks has supplied the following notes and descriptions, the localities from which I collected the fossils being at the same time carefully distinguished. Fuller descriptions, with figures, will appear in a later publication.

Silurian Fossils on Severn and Fawn Rivers

B.—Limestone Rapids, Severn River.

STROMATOPOROIDS:—

Actinostroma tenuifilum, Parks.—Three specimens in which the structure is largely destroyed, but which are probably referable to this species.

CORALS:—

Favosites gothlandica, Lamarck.

Favosites hisingeri, Milne-Edwards and Haime.

Pycnostylus guelphensis, Whiteaves.

Pycnostylus elegans, Whiteaves.—Some of the specimens referred to this species show certain differences which may demand the creation of a new species.

Zaphrentis stokesi, Milne-Edwards and Haime.

Aphyllostylus gracillus, Whiteaves.—One specimen in a poor state of preservation which is provisionally referred to this species.

Tyrrellia severnensis, gen. nov., sp. nov.—One specimen of a coral which does not seem to belong to any described genus. The corallites are single, cylindrical and elongated having a diameter of 5 mm. Septa numerous, reaching almost to the centre on the upper surface of each tabula, but not extending to the next tabula above except at the periphery. The septa therefore appear as a circle of radiating plates on each tabula, having the full height of the intertabular space at the periphery but diminishing to nothing at the centre. The tabulae are about 0.5 mm. apart: they are flat or slightly convex at the centre, but are sharply inflected downwards at their margins. No other endothecal structures are apparent.

BRACHIOPODS:—

Rhynchospira lowi, Whiteaves.—One imperfect cast probably referable to this species.

GASTROPODS:—

Hormotoma patriciaense, sp. nov.—One cast showing three whorls. Total height 100 mm. Width of body whorl about 50 mm. Sutures deep. Whorls evenly convex. Apical angle about the same as in *H. winnipegense*, Whiteaves, but the present species is more elongate; for a given height of whorl, the width is not more than two-thirds that of *H. winnipegense*. The form should perhaps be referred to the genus *Fusispira*.

Bellerophon, sp. indet.—Four casts of a bellerophon which probably represent a new species but which are too imperfect to warrant description at present.

Megalomphala robusta, Whiteaves.—One imperfect cast agreeing fairly well with Whiteaves' figures of this species.

Strophostylus filicinctus, Whiteaves.—One cast probably referable to this species.

Trepospira cf. kokeni, Lindström.—Cast and mould of a small shell which is probably related to the above form described by Lindström from the Silurian of Gothland.

Gyronema or *Poleumita hudsonica*, sp. nov.—Several imperfect casts of a large specimen of more than three inches in diameter, also a portion of the body whorl of a smaller individual. The specimens differ from *G. speciosum*, Whiteaves, in having the revolving carinae more widely spaced on the upper than on the lower side of the whorl. The spire is apparently depressed so that the general form is comparable with that of certain examples of *Poleumita scamnata*, Clarke and Ruedemann.

Coelocaulus cf. macrospira, Hall.—Imperfect casts of a form which must be closely related to this species. Practically indeterminable.

Clathrospira, sp.—A large but broken cast very closely resembling *C. deiopea*, Billings, from the Guelph of Ontario.

Eotomaria, sp.—A single cast with the upper part of the spira lacking. Resembles *E. durhamensis*, Whiteaves, from the Guelph of Ontario.

Euomphalopterus tyrrelli, sp. nov.—Portions of the internal cast of a large form measuring fully eight inches in diameter. The outer whorl has a width of two inches: it is evenly rounded on the inner side, but the outer side is convex above and slightly concave below with a sharp carina at the inferior margin. The whorls decrease in diameter very slowly so that there must be about seven volutions in all. Lacking any portion of the shell, generic relationships are hard to determine. The shape of the whorls, the wide open umbilicus and the slightly ascending spire seem to suggest the genus *Euomphalopterus*.

Euomphalopterus, sp.—A single cast of the interior which resembles that figured by Billings as *Pleurotomaria elora*. The present form is smaller and, lacking any portion of the shell, gives no indication of the external features characteristic of Billings' species.

Trochus ?? sp. indet.—Two small casts of interiors resembling some of the forms described by Lindström as *Trochus* from the Silurian of Gothland.

Lophospira or *Coelocaulus*, sp. indet.—One imperfect mould of the exterior. Most of the whorls show a rounded outline, but there is some evidence that an acute alation was present. The form is probably related to species described as *Pleurotomaria valeria* by Billings or as *P. velaris* by Whiteaves.

Liospira ?? sp. indet.—Two casts of a small shell with a very deprèssed spire and with an acute edge on the body whorl. Resembles the Ordovician genera *Raphistoma* or *Raphistomina*.

Diaphorostoma cf. perforatum, Whiteaves.—A broken cast of the apical portion of a shell which resembles Whiteaves' figure in its general contour.

PELECYPODS:—

Pterinea, sp. indet.—An imperfect cast with the wing broken off. Compare also *Ambonychia septentrionalis*, Whiteaves.

Modiomorpha acuminata, sp. nov.—Several specimens, some with the shell preserved, very pointed at the anterior end, length about 70 mm. These shells will admit of accurate description.

CEPHALOPODS:—

Orthoceras, sp.—Several specimens of an *Orthoceras* or possibly a slightly surved *Cyrtoceras*. Diameter posterior to the body chamber 35 mm. Siphuncle fairly large and slightly eccentric. This form probably represents a new species but it would be hazardous to describe it as such at present. The form is certainly not *O. ekwanense* of Whiteaves.

Phragmoceras whitneyi, sp. nov.—One cast of the body chamber of a very large form. The aperture is fully six inches across and the diameter of the body chamber at its posterior end is four inches. The cast shows a faint indication of a beaded ornamentation. The general shape of the body chamber is much like that of *P. lineolatum*, Whiteaves, but the much greater size seems to justify the establishing of a new species.

?? *Phragmoceras lineolatum*, Whiteaves.—One crushed and broken cast of the body chamber and two air chambers. The ovate outline and the size and position of the siphuncle correspond with Whiteaves' figures, but the ears of the body chamber are broken off so that certain identification is impossible.

Phragmoceras, sp.—Several fragments of the separate portion of a species of this genus with the septa varying from 3 mm. apart on the concave side to 7 mm. on the convex. It is impossible to state whether these fragments belong to the other species listed.

Cyrtoceras, sp. nov.—Cast showing 16 air chambers in a length of 40 mm. Slightly curved. Siphuncle small, eccentric, but not marginal. Resembles *C. orodes*, Billings, but it is less curved and the siphuncle has a different position.

??*Barrandeoceras*, sp. indet.—Portion of the body chamber of a coiled Cephalopod possibly referable to this genus. Section ovate, 24 by 28 mm. in diameter.

Endoceras hudsonicum, sp. nov.—Shell large, four inches or more in diameter. Septa strongly curved, about 7 mm. apart as measured on the surface. Siphuncle 35 mm. in diameter. Funnels reach just to the next septum apicad. No endosiphuncular structures apparent. Siphuncle 20 mm. from the margin of the presumably ventral side. Possibly should be ascribed to the genus *Nanno*.

Actinoceras hearsti, sp. nov.—Shell large, gently tapering. The specimen shows a diameter of about 4 inches. Siphuncle strongly nummuloid, large and marginal, with a central endosiphuncle, diameter 50 mm. Nummuloid beads oblique at about 15 degrees. Rings not evenly convex but greatest anteriorly. Siphuncle less than 5 mm. from the margin. This specimen is much larger than *A. keewatinense*, Whiteaves; it resembles *A. richardsoni* magnum in which the siphuncle is of about the same size but in which the septa are much closer together, and in which the nummuloid beads are of a more regular outline.

TRILOBITES:—

Illaenus (*Bumastus*) *cf. ioxus*, Hall.—Portion of a buckler which seems to correspond with this species.

C.—The ten-mile stretch above the Limestone Rapids, Severn River; slightly newer geologically than B.

CORALS:—

Halysites catenulatus, Linnaeus.
Streptelasma, sp. indet.

BRYOZOA:—

Fenestella subarctica, Whiteaves.

BRACHIOPODS:—

Pentamerus oblongus, Sowerby.
Trimerella ekwanensis, Whiteaves.
Glassia variabilis, Whiteaves.
Spirifer crispus, Hisinger.

Delthyris cf. sulcata, Hisinger.—Two casts are very doubtfully referred to this species.

Recticularia cf. septentrionalis, Whiteaves.—One cast of a small example of this species.

Gypidula sp.—Several specimens of casts of small Pentameroid shells requiring further investigation.

Stropheodonta, sp. indet.—Several small stropheodontoid casts impossible of identification.

GASTROPODS:—

Gyronema dowlingii, Whiteaves.
Gyronema speciosum, Whiteaves.—A small fragment doubtfully placed here.

Diaphorostoma perforatum, Whiteaves.—A crushed and broken body whorl possibly belonging to this species.

Bellerophon, sp. indet.—Apparently the same species as from the Limestone rapids.

CEPHALOPODS:—

Gomphoceras, sp. indet.—Two casts of the body chambers of small individuals of indeterminable species.

D.—Assina Rapids, Severn River.

CORALS:—

Favosites hisingeri, Milne-Edwards and Haime.
Zaphrentis stokesi, Milne-Edwards and Haime.
Acervularia austini, Salter.

BRACHIOPODS:—

Camarotoechia ekwanensis, Whiteaves.—One cast resembling this species. The specimen is somewhat less gibbous than the type.

GASTROPODS:—

Hormotoma whiteavesii, Clarke and Ruedemann.—Three casts of interiors indistinguishable from this species.

Euomphalopterus valeria, Billings.—One very perfect cast of the interior and one mould of the umbilical side. As far as can be judged from casts, these specimens belong to Billings' species.

Phragmoceras cf. whitneyi, sp. nov.—A fragment showing 14 air chambers. This septate portion might well accompany the body chamber herein described as *P. whitneyi.* There is no proof beyond the resemblance in size that the two portions represent the same species.

Actinoceras, sp. nov.—One siphuncular segment of a species evidently different from any other in the collection. The ring is about 55 mm. by 43 mm. with a very distinct endosiphuncle of 12 mm. in diameter. If the direction of the endosiphuncle represents the axis of the shell as it probably does, the siphuncular rings are inclined at a very high angle—considerably more than 45 degrees from the transverse position. The rings are therefore very asymmetric and appear to have been strictly marginal in position.

E.—Limestone Rapids, Fawn River.

CORALS:—

Halysites catenulatus, Linnaeus.

?? *Petraia occidentalis*, Whiteaves.—A small form of Streptelasma or Petraia resembling this form externally. Requires microscopic examination.

BRACHIOPODS:—

Rhynchospira lowi, Whiteaves.
Plectambonites transversalis, Wahlenberg.
Meristina expansa, Whiteaves.

TRILOBITES:—

Encrinurus cf. arcticus, Salter.—One badly preserved and partly exfoliated pygidium, possibly belonging to this species.

These fossils show that the rocks are similar in age to those found by Messrs. McInnis and Dowling on the Winisk and Equan rivers, and that they are approximately of the age of the Guelph limestones of Ontario or of the Middle Silurian of the ordinary stratigraphic series.

Pleistocene

Glacial and Post-Glacial

The hard rocks which have just been briefly described do not seem to have been covered by any sediments laid down between the end of the Silurian period and the beginning of Glacial times, or if such sediments were deposited on any parts of the country they have been completely removed and no trace of them is now to be seen.

The series of events which inaugurated the Glacial Period in this district would appear to have been somewhat as follows:—

From a centre lying to the west of the northern portion of Hudson Bay, somewhere in the vicinity of latitude 62, a glacier which, when I determined its existence in 1894, I called the Keewatin glacier, moved southwards and southeastwards far down across the basin of lake Winnipeg and an undetermined distance into the country east of lake Winnipeg. It brought with it clays, sands and fragments of rock from the western side of the basin of Hudson Bay and distributed them along its course.

After this Keewatin glacier began to shrink and to withdraw from the country which it had occupied for a long period of time, another great glacier formed on the higher level somewhere between Hudson Bay and Lake Superior and flowed northward, and doubtless also westward and southward, over the surrounding lower land. At the same time the basin of Hudson Bay itself was probably larger than it is at present, and was being filled by marine sedimentary deposits.

For this glacier, which has now been definitely recognized for the first time, I propose the name Patrician glacier, to distinguish it from the Keewatin glacier to the west and the Labradorean glacier to the east. The name proposed is derived from that of the immense new district in northern Ontario to which Her Royal Highness the Princess Patricia, daughter of His Royal Highness the Duke of Connaught, Governor-General of Canada, graciously permitted her name to be applied, for in it, somewhere between Trout Lake and the Albany River, this great glacier would appear to have had its centre and gathering ground.

Photo by J. B. Tyrrell, Oct. 4, 1912.
Point of glaciated rock at the south side of Weagamow lake.

As time went by this Patrician glacier gradually dwindled away and the Labradorean glacier assumed the most commanding size and position. It swept down from the highlands of Labrador, crossed the southern portion of the basin of Hudson Bay, and ascended to the watershed south of Hudson Bay, but whether it ever actually crossed this watershed or whether the more southern glaciers that have previously been regarded as portions of the Labradorean glacier have actually been parts of the older Patrician glacier or not, I am not as yet quite certain.

On its way the Labradorean glacier which, while crossing the basin of Hudson Bay, must have been buoyed up to a certain extent by water pressure, scooped up the marine sediments which had accumulated in the Bay and moved them southward over what is now land. This sediment so moved has now lost its sedimentary character, for it has been kneaded up with the shells and any other material contained in it into a homogeneous mass, with but few boulders, though those which it does contain are usually

Photo by J. B. Tyrrell, Sept. 30, 1912.
Surface of Kawagami moraine covered with burnt timber.

Photo by J. B. Tyrrell, Oct. 9, 1912.
Morainic hill of boulders overlying a gray gneiss on the second portage east of Geechika or Little Cedar lake.

striated. The Labradorean till or boulder clay is found to extend in a continuous sheet for about 150 miles back from Hudson Bay, while farther north there are also large, but probably discontinuous, areas covered with similar clay. It is possible that some of this till is now lying not very far from where it was first deposited as marine sediments, but nevertheless it has certainly all been moved and kneaded to some extent by the overriding glacier, for wherever the till had been completely removed the underlying rock was seen to have been strongly scored by this movement.

This clay would doubtless form a rich, fertile soil which could be easily worked by the agriculturist, for the amount of shelly material which is included in it makes it loose and friable.

Besides this vast expanse of till, the Labradorean glacier left a great series of moraines, with accompanying eskers and sand plains, stretched across the country. The last moraine formed on its retreat would appear to have been dropped into the waters of Hudson Bay.

After the Labradorean glacier had retired northward the sea occupied a position about four hundred feet higher than its present level, and marine sands and clays were deposited over the till, such marine deposits being seen on the tops of the cliffs overlooking the streams almost everywhere throughout the last hundred miles from Hudson Bay.

A detailed account of the beds of clay which occur along the course of the various streams followed on the way from Hudson Bay to the Grand Trunk Pacific railway is quite unnecessary here, as it is much better shown on the accompanying map, but nevertheless a few typical examples may be interesting.

On the lower portion of the Severn river till is first seen at a distance of about twenty miles from the mouth, where, in a cliff fifty feet high, the lower twenty-five feet are composed of dark brownish gray till with many striated boulders, among which are some of a hard red conglomerate, similar to the Athabasca sandstone and conglomerate which outcrops in the country northwestwards from Fort Churchill, and also many boulders of a fine-grained greenish-brown quartzite or graywacké which consists of quartz grains in a calcareous and argillaceous cement. Some roundish portions of this rock are much more calcareous than the rest, and these calcareous portions weather out fairly easily, making rounded white spots on the surface of an otherwise dark coloured boulder. On account of this peculiarity of weathering, these boulders are conspicuous and easily recognized, and as they are scattered throughout the till from the mouth of the Nelson river eastward at least to the Severn river, they must have been originally derived from an extensive area of quartzite. Up to the present, however, I have not been able to learn of anyone who has seen similar quartzite in place, and therefore the exact place of origin of these boulders is unknown. However, they are not very unlike the quartzite at Fort Churchill, and may possibly have been derived from an eastern extension of the Churchill quartzite. Besides these two rocks, boulders of granite, limestone, etc., which did not appear to have any specific characteristics were also common in the till.

Silurian Fossils on Nelson and Hayes Rivers

At the mouth of the Nelson river the till is very similar in character to that on the Severn river, but limestone pebbles are more numerous, and all appear to be of Silurian age. As proof of the age of these limestonese the following species of fossils were collected from loose fragments of limestone on the banks of the Nelson and Hayes rivers:

Favosites gothlandica.
Acervularia austini.
Conchidium decussatum.
Rafinesquina alternata.
Atrypa reticularis.
Phragmoceras parvum.

Cyrtoceras cordatum.
Actinoceras n. sp.
Isochilina grandis var. *latimarginata.*
Leperditia hisingeri.

Professor Parks supplies the following notes and descriptions of the above species:

F.—Drift at mouth of Nelson river:—

Favosites gothlandica, Lamarck.—A small and doubtful specimen.

Streptelasma or *Zaphrentis* sp. indet.

Acervularia austini, Salter.

Conchidium decussatum, Whiteaves.

?*Rafinesquina alternata*, Emmons.—Several *Strophomenoid* shells of which one strongly resembles this species. All are mere casts.

Phragmoceras cf. parvum, Hall and Whitfield.—Several casts of a species closely resembling this form.

Cyrtoceras cordatum, sp. nov.—One cast of the interior of the septate portion. Curvature, slight. Section, ovate, at the anterior end of the specimen, measuring 24 mm. dorso-ventrally and 19 mm. laterally. The venter is marked by a distinct cordate prominence, near which is situated the small elliptical siphuncle. The septa are about 2 mm. apart. This form suggests *C. cuneatum*, Whiteaves, but it is not co-specific, as the septa are 6 mm. apart in that species. The following remark by Dr. Whiteaves *re C. cuneatum* would apply equally well to this specimen. "It is evidently not a true *Cyrtoceras*, but a probably new generic type, which there is not yet sufficient material to define satisfactorily." In the same piece of rock is a species of *Lophospira*, not seen elsewhere in the collection.

H.—Drift on Hayes river, near York Factory.

Actinoceras sp. nov.—This form is nearer to *A. keewatinense*, Whiteaves, than any other in the collection. It is, however, less oblique and the rings are much narrower and closer together.

Isochilina grandis var. *latimarginata*, Jones.—Several casts closely resembling this form, but perhaps varying a little in the form of the tubercle.

Leperditia hisingeri, Schmidt.

K.—Drift on Hayes river.

Atrypa reticularis, Linnaeus.

Acervularia austini, Salter.—Several rolled pebbles of fine-grained corals or bryozoans which will require microscopic examination.

In addition to boulders of limestone, granite, diorite, etc., the till of this locality contains others of brownish quartzite with whitish eyes, similar to those mentioned above, greenish diabase, anorthosite, red Athabasca sandstone, Iron formation, and red porphyritic rocks similar to those which I found in 1893 occurring in the vicinity of Dubawnt Lake.

Mr. Ellis Thomson has furnished the following descriptions of microscopic sections of some of these boulders of red porphyry:—

No. 1.—A porphyritic rock with large phenocrysts of orthoclase and smaller ones of quartz in a medium-grained ground-mass of quartz, orthoclase and iron oxide. Ilmenite and apatite are rare constituents while the two alteration products, chlorite and leucoxene, are present in considerable quantities. The quartz crystals are for the most part fresh, but the feldspar phenocrysts are considerably weathered.

No. 2.—Another porphyritic rock with phenocrysts of plagioclase and orthoclase, as well as a very few quartz crystals, in a fine-grained ground-mass of needle-like feldspars (mostly plagioclase), quartz, chlorite, and hematite, the quartz showing granophyric structure. Magnetite and apatite are fairly prominent accessory constituents. The alteration products, chlorite, serpentine, and calcite, are also present in appreciable amounts. This rock probably corresponds most closely in composition to the micropegmatites or granophyres, similar to those found in the Sudbury district, although so greatly altered as to make this identification doubtful.

No. 3.—A highly weathered porphyritic rock with phenocrysts of plagioclase, orthoclase, and quartz. The ground-mass is very fine-grained, and is composed of quartz, feldspar, and iron oxide, the quartz showing granophyric structure. Magnetite, epidote, and chlorite are present in considerable quantities, while ilmenite. leucoxene, apatite, and fluorspar are more or less rare constituents.

The Northern Tills

On Hayes river the heavy bed of till extends up as far as Swampy lake, at an elevation of 500 feet above the sea. This is about the same elevation to which till extends as a regular uniform sheet on the Severn river farther east.

As we ascended the Severn river the underlying limestone was everywhere found to be covered by till similar to that above described. Also after leaving the Severn river and branching into its large eastern tributary which is known on the map as the Fawn river, though this name is unknown to the Indians of the vicinity, the banks continued to be formed of similar till. In many places there is a distinct horizontal dividing line in this till, and just beneath that line is often a well defined boulder pavement with the upper surfaecs of the boulders planed off and strongly grooved and striated in a direction north 10° west or south 10° east.

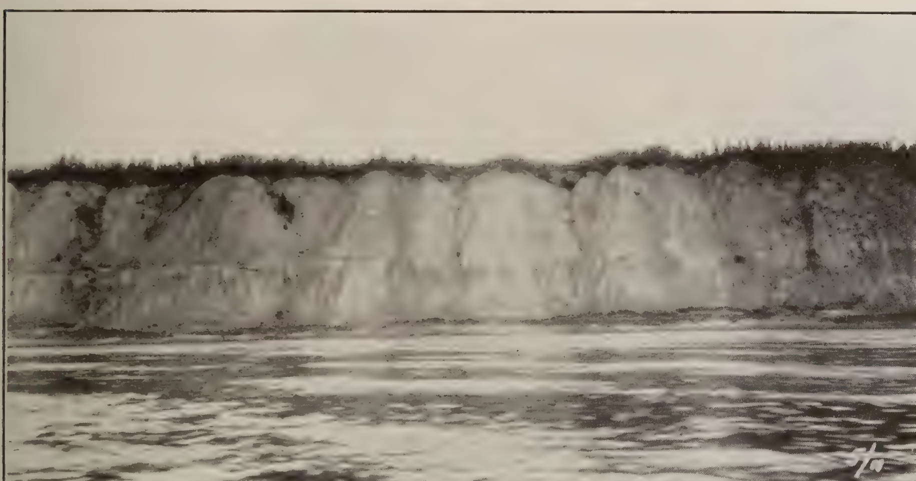


Photo by J. B. Tyrrell, June 29, 1912.
Cliff showing the upper and lower till on the bank of the Shamattawa river.

On the Hayes river the upper and lower tills are often separated by a bed of stratified sand or gravel in which I searched in vain for fossils of any kind; on the Shamattawa river this dividing layer of sand was also often conspicuous, and in one place in it, as well as for a foot or two up into the till above the sand, moss and wood, partly altered to lignite, were recognized.

These banks of till continued uninterruptedly all the way up the Severn river to within a short distance of the lowest granite outcrop, when they gradually disappeared.

Through much of the distance from the mouth of the Severn up to the first exposure of granite rock the till was overlain by a varying thickness of stratified sands and clays carrying marine fossils. The surface of the till beneath these marine deposits is for the most part remarkably even and regular, no prominent hills or valleys being recognisable, except such as have been formed by later denudation and erosion. This regularity in the old surface contour of the till is a remarkable feature. It emphasizes the mental impression created by the nature and character of the till itself, namely, that it is simply a marine deposit nearly in place, which has everywhere lost its definite stratified character. Wherever it is seen to be underlain by rock there is evidence that it has been moved over that rock, for the rock is strongly grooved and polished. The boulders and pebbles which are contained in the till have been distinctly striated by movement over each other.

This vast area in the northern part of the district of Patricia, and in the adjoining portion of the Province of Manitoba, which is covered by till and marine sands and clays, has an average slope of about five feet to the mile northward towards Hudson Bay. This is abundantly sufficient to enable it to be effectively drained, and when drained it should prove to be a rich agricultural land, the southern portions of which would doubtless grow grains, such as are ordinarily grown in Manitoba and in the valley of the Saskatchewan, while the northern portions would furnish an abundant supply of grass and fodder for cattle and horses.

A short distance south of the mouth of Fawn river a ridge runs east and west roughly parallel to the shore of Hudson Bay. This ridge has not yet been explored, but judging from such information as was obtainable about it, it would appear to cross the Hayes river near the mouth of the Shamattawa, and thence to extend eastward as a series of lumpy hills, with intervening lakes, which constitute a famous hunting ground

Photo by P. E. Hopkins, Sept. 17, 1912.
Lowest exposure of granite on Fawn river, showing two sets of glacial grooves and striae running respectively North 30° West and South 40° West.

for some of the Indians at York Factory, and are known to them as the " Wachi " or Mountain. Thence it continues on, across the head waters of Goose river, Goose lake being one of the lakes by which it is broken, thence across the Severn river and away into the country towards the east. On looking at the map it may be seen that the lower course of the Fawn river and the long west to east course of the Winisk river are controlled by it. At first this ridge seemed to me to be simply an old shore line of Hudson Bay. While it is doubtless such a shore line, I am reasonably satisfied now that it follows an old water-laid moraine of the Labradorean glacier which was laid down in the bottom of Hudson Bay as the face of the glacier receded northwards. As it was laid down in the water it does not exhibit the same rough, irregular characters as many of the moraines hereafter to be described in the higher country farther south.

Near the first exposure of granite rock on Fawn river, which is at an elevation of about six hundred feet above the present sea level, the surface of the country assumes a more stony character than it had farther north, and gravel ridges which are either eskers or beaches of extra-glacial lakes make their apperance. Thus we have here evidently reached a point where we are above and beyond the post-glacial marine sediments.

Clayey till continues to fill the bottoms of all the depressions and, in fact, to cover all the country except the more prominent rocky points.

Still farther south the rocky points become more prominent and rise to somewhat higher positions above the till. However, the clayey till is still the governing factor in the country southward to Trout lake and beyond it.

On the south side of Trout lake a high granite ridge rises as a conspicuous feature. Our course was up Mishwamágan river, a small stream which flows into the south side of the lake and breaks through and across this granite ridge in a series of heavy rapids. On the top of and on the southern slope of the granite ridge a large number of boulders, chiefly of granite, but some of greenstone, are scattered over the surface, and these doubtless represent a moraine which marked the front of the Labradorean ice sheet at one time in its southern advance. As this is the first strongly marked land moraine recognized on our journey southward this summer it will be convenient to designate it as the Trout lake moraine.

Photo by J. B. Tyrrell, Oct. 4, 1912.

Field of potatoes at Hudson Bay Company's trading post, Trout lake, District of Patricia, Ontario.

From the Trout lake moraine southward the country for a number of miles has comparatively little soil on it, the gray granite forming the surface for considerable areas. The fact that the forest was burned some years ago, and that a new growth has not yet started, tends to give the district a decidedly forbidding aspect. The presence of a great number of lakes between the rocky hills also clearly indicates that the supply of loose material left here on the retirement of the glacier was small, not being sufficient to fill even the minor depressions on the surface.

The ascent of Mishwamágan river was broken by many rapids, past which it was necessary to carry the canoes and outfit on trails which had been moderately well cut out by the Indians.

Near the source of this river is a lake called Kawagami lake which is surrounded by stony morainic hills, giving evidence of the deposition of a heavy moraine on the top of a secondary height of land. This moraine is one of the strongest seen during the summer and may be designated as the Kawagami moraine. To the south of this moraine lie Kwyuswagami and Makoop lakes, both extensive bodies of water lying in the midst of comparatively low country, the surface of which is chiefly composed of stony clay or till interspersed with ridges of sand and rounded gravel. Both these lakes, but chiefly the latter, are recognized by the Indians as being excellent fishing places. There is a small and permanent Indian village on the shore of Makoop lake. It is interesting to note that the best fishing lakes in the northern parts of Canada usually lie in country which is more or less thickly covered with clay and soil, and that the bottoms of these lakes are composed of mud. Whitefish, on which the natives mostly rely for food, favour a mud bottom, on which they can obtain an abundant supply of the lower forms of animal life on which they feed.

At the Indian village on Makoop lake potatoes seem to be regularly grown, and I was surprised to see a number of sharp-tailed grouse or Manitoba prairie chicken flying about.

From Makoop lake southward to Weagamow lake the country is covered by glacial clays and sands, though higher rocky hills rise as bare knolls above the general level.

Weagamow lake itself is an extensive though shallow sheet of water which lies in a basin of glacial clay. The glacial clay extends southward along the course which we followed up the Saskatchewawa river to Agutua lake, which lies at the foot of a number of high, sandy, esker-like hills. These hills of sand and gravel in their turn rest, in some cases at least, on the tops of stony morainic ridges.

The canoe route that we were following crossed a portage three and a half miles long over the top of one of these esker ridges from Agutua lake to Windigo lake, the latter of which is also surrounded by banks of sand and clay.

The great moraine which crosses the country near Agutua lake may be designated the Agutua moraine, and it is not improbable that the last advance of the Labradorean glacier terminated at it or in its vicinity.

From Windigo lake southward to the height of land the clay-covered areas become less and less frequent and extensive, and from the height of land southward around Cat lake and down Cat river to lake St. Joseph such deposits of drift as exist consist mostly of stony and sandy ridges, many of which have a definite esker-like character, and sand plains, doubtless formed by overwash near the face of the glacier.

From the above description of the drift-covered parts of the district of Patricia it will be seen that the Labradorean glacier, as it advanced southward up the slope from Hudson Bay, distributed a covering of till over large areas of country, and most of this till is not too stony to be of definite value for agricultural purposes. The extent of the land so covered is as yet quite unknown, but it will undoubtedly amount to tens of thousands of square miles.

Evidences of Glaciation

It is evident from what has been said above that the clay-covered areas are dependent for their existence, present position and condition on the glacial history of the country.

A short summation of this history was given at the beginning of this chapter, but it may be interesting to enumerate in somewhat greater detail a few of the observations on which that summary was founded.

At the Limestone rapids, twenty-eight miles above the mouth of the Severn river, there is a thickness of about thirty-five feet of till above the limestone, and the surface of the limestone, where it has not been exposed for any length of time, is beautifully scored in a direction south 55 degrees west by the movement of the Labradorean glacier over it. In some protected recesses, grooves and striae running north 5 degrees east were seen, caused by the northward movement of the Patrician glacier before the advance of the Labradorean glacier.

Farther up the Severn river the Labradorean glacier was evidently buoyed up or supported in some way so that it did not touch the underlying limestone for, throughout a distance of eight or ten miles, the rock is everywhere scored by grooves and striae pointing from north to north 10° west, the direction of the movement being often quite clearly defined. How the glacier was supported is not clear. It is hardly possible that the water could have been sufficiently deep to float it, so that it is likely that it slid over some of the till of the pre-existing glacier which had here remained frozen.

Near the mouth of the Fawn river, at a distance of sixty miles or thereabouts from Hudson Bay, the rock is again scored in a direction south 60° west by the Labradorean glacier, but on Fawn river, just where the limestone was last seen at the south end of a little cliff, the scorings of the Patrician glacier are again quite discernible bearing north 10° east.

Photo by J. B. Tyrrell, Oct. 12, 1912.
Glaciated gneiss on the height of land portage between Severn and Cat rivers. The rifle points in the direction of the striation, which is South 80° West.

At the first granite rock seen on the Fawn river the scorings of the two glaciations are quite distinct. The scorings of the first one trend north 30° west, and show in protected recesses on a slightly irregular surface generally scored by the Labradorean glacier which moved south 40° west.

Thence southward all the way to Trout lake the two sets of scorings are quite distinct and recognizable, the later ones belonging to the Labradorean glacier, having however rather more definite courses than those of the earlier Patrician glacier, which swung slightly more to the west as it went farther and farther south.

In Trout lake itself the evidences of these two glaciations are beautifully clear and distinct. Many low rocky islands rise a few feet above the surface of the water, and it is at once noticeable that these islands differ from most of those seen in glaciated countries, inasmuch as they are rounded up from almost all sides, the only rough broken surfaces being to the west. On a closer examination it is found that they have at first been heavily planed and scored by a glacier moving north 25°—north 40° west, after which they have been again planed and grooved by a glacier moving south

40° west. The first planation was caused by the Patrician glacier, which would appear to have had a centre somewhere in the high country to the southeast of Trout lake, while the second was caused by the Labradorean glacier from the northeast.

South of Trout lake the evidences of the two distinct glaciations are often much more difficult to decipher, but there is no doubt that the Labradorean glacier extended as far south as the height of land where it formed the great Agutua moraine, and at the same time it also formed the high eskers which now rise as steep hills on the height of land and constitute the most conspicuous features in the whole region.

South of the height of land the presence of the Labradorean glacier is not by any means certain, for it is quite possible that all the scorings, moraines, eskers, and other glacial phenomena may have been caused by the westward or southwestward moving portions of the Patrician glacier which had its centre east of our line of travel on the height of land itself. The absence or rarity of scoring on the rocks of the height of land would appear to support this latter conclusion.

Photo by J. B. Tyrrell, June 24, 1912.
Grooves and striae running South 25° East, made by the Keewatin glacier on "The Rock" in Hayes river.

West of the Severn river, and between it and the Hayes river, very few records of glacial conditions have been made, but on the Hayes river itself I found evidence at "The Rock," which is the lowest exposure on the river, that there was a western-moving glacier which was probably the western extension of the Patrician glacier, subsequent to which there was a southeastern advance of the Keewatin glacier. The hill on the east side of Hayes river, which is known as "The Hill" or Chacutinaw, is an esker from one of these glaciers resting on top of a morainic ridge which extends away to the east, the conditions being very similar to those at the sandy hills at the head waters of the Severn river.

The following list of glacial striae observed during the summer will give any glacialist a clear idea of the conditions as we found them.

Glacial Striae on the Severn, Albany and Winnipeg Rivers

Sept.	5.	Severn R. Limestone Rapid	1st.	N. 5°-10° E.
Sept.	7.	Severn R.	2nd.	S. 55° W.
Sept.	7.	Severn R. 2½ m. above Limestone Rpd.		N. 10° W.
Sept.	7.	Severn R. 3 m. above Limestone Rpd.		N. 10° W.
Sept.	7.	Severn R. 3½ m. above Limestone Rpd.		N.
Sept.	7.	Severn R. 3.6 m. above Limestone Rpd.		N. 10° W.
Sept.	7.	Severn R. 7.2 m. above Limestone Rpd.		N.
Sept.	9.	Severn R. Limestone cliff		S. 60° W.
Sept.	9.	Fawn R. Limestone cliff		S. 60° W.
Sept.	9.	Fawn R. Limestone cliff		N. 10° E.
Sept.	10.	Fawn R. Boulder pavement		N. 10°-20° W. or opp.
Sept.	17.	Fawn R. First rock	1st.	N. 30° W.
			2nd.	S. 40° W.
Sept.	17.	Fawn R. First Portage		S. 45° W.
Sept.	19.	Fawn R. Ninth Portage		S. 45° W.
Sept.	19.	Fawn R. Tenth Portage		S. 50° W.
Sept.	19.	Fawn R. Eleventh Portage		S. 50° W.
Sept.	20.	Fawn R. Twelfth Portage	1st.	N. 15° W.
			2nd.	S. 40° W.
Sept.	20.	Fawn R. 1 mile above Twelfth Portage	1st.	N. 15° W.
			2nd.	S. 40° W.
Sept.	20.	Fawn R. Thirteenth Portage	1st.	N. 20° W.
			2nd.	S. 40° W.
Sept.	20.	Fawn R. Between 14th and 15th Portages	1st.	N. 30° W.
			2nd.	S. 40° W.
Sept.	21.	Fawn R. Below Sixteenth Portage		S. 40° W.
Sept.	21.	Trout Lake Island, 4 miles w. of river	1st.	N. 25° W.
			2nd.	S. 35° W.
Sept.	21.	Trout Lake Island, 2 miles w.	1st.	N. 35° W.
			2nd.	S. 40° W.
Sept.	23.	Trout Lake, Hudson Bay Island	1st.	N. 30° W.
			2nd.	S. 40° W.
Sept.	24.	Trout Lake, Big Island	1st.	N. 40° W.
			2nd.	S. 40° W.
Sept.	24.	Island 2 m. s. of Big Island, Trout Lake	1st.	N. 40° W.
			2nd.	S. 40° W.
Sept.	27.	Mishwamagan River		S. 45° W.
Sept.	30.	Kwyuswagami		S. 80° W.
Sept.	30.	Makoop Lake		N. 65° W.
Sept.	30.	Makoop Lake		S. 85°-90° W.
Oct.	1.	Negigamo River		S. 20° W.
Oct.	2.	Ningitowa River		S. 55° W.
Oct.	2.	Ningitowa River, Ojiji Rapid		S. 60° W.
Oct.	2.	Ningitowa River, Wapekemung Rapid		S. 60° W.
Oct.	3.	Ningitowa River, Cheassin Lake		S. 25° W.
Oct.	4.	Ningitowa River, Kabadenegum Portage		S. 35° W.
Oct.	4.	Weagamow Lake		S. 55° W.
Oct.	4.	Saskatchewawa River		S. 55° W.
Oct.	5.	Saskatchewawa River		S. 55° W.
Oct.	8.	Windigo Lake, Island		S. 15° E.
Oct.	8.	Windigo Lake, Lunch		S. 5° E.
Oct.	8.	Windigo River, Chepowestik		S. 5° W.
Oct.	9.	Windigo River		S. 20° W.
Oct.	9.	Windigo River, 44th portage		S. 5° W.
Oct.	9.	Windigo River, 46th portage		S. 25° W.
Oct.	11.	Kishika River, 54th portage		S. 75° W.
Oct.	12.	Kishika River, S. 63rd portage		S. 85° W.
Oct.	12.	Wapasiniskak		N. 85° W.
Oct.	12.	Wapasiniskak		S. 85° W.
Oct.	13.	Cat River. 65th portage		S. 82° W.
Oct.	15.	Cat River. 70th portage		S. 55° W.
Oct.	15.	Cat River. Below 70th portage		S. 65° W.
Oct.	15.	Cat River. Smoothrock Lake, entrance		S. 60° W.
Oct.	15.	Cat River. Smoothrock Lake, Narrows		S. 60° W.
Oct.	15.	Cat River. Smoothrock Lake, Outlet	1st.	S. 10° E.
			2nd.	S. 25° W.
			3rd.	S. 55° W.
Oct.	16.	Cat River. 72nd portage		S. 52° W.

Oct. 17. Cat River. Camp 16-17		S. 70° W.
Oct. 17. Cat River. 75th portage		S. 65° W.
Oct. 17. Cat River. 3 m. above Blackstone Lake		S. 47° W.
Oct. 18. Lake St. Joseph		S. 55° W.
Oct. 18. Lake St. Joseph		S. 45° W.
Oct. 19. Root River		S. 40° W.
Oct. 21. Lac Seul. Old H. B. Warehouse	1st	S. 65° W.
	2nd.	S. 50° W.
Lac Seul. Lunch	1st.	S. 70° W.
	2nd.	S. 50° W.
Oct. 22. Lac Seul. Lunch		S. 45° W.
Oct. 23. River		S. 45° W.

Striae Observed on the Hayes River in Manitoba

Hayes River:—		
June 24. The Rock	1st.	S. 65° W.
	2nd.	S. 85° W.
	3rd.	S. 20° E.
June 24. 1 mile above The Rock		S. 25° W.
June 24. Rocky Rapid, 4½ miles above "The Rock"	(grooves)	S. 20° W.
	(grooves)	S. 60° W.
	(grooves)	N. 75° W.
	(striae)	S. 40° W.
June 23. 2 miles below Nisotaniga Rapids		East or West.
June 19. Oxford Lake		S. 50° W.
June 17. Pot-hole point, Pine Lake		S. 50° W.
June 17. Jackpine Rapid		S. 50° W.
June 14. Near upper end Robinson portage		S. 45° W.
June 13. Echimamish River		S. 42° W.
June 12. Nelson River		S. 50° W.

Recent Deposits

On the maritime plain in the northern part of the district of Patricia the recent deposits are represented chiefly by clays and sands which have been laid down in the receding waters of Hudson Bay on top of the previously formed beds of glacial till. In most cases these deposits are rather thin, for the supply of sediment appears not to have been abundant.

On the lower portion of the Hayes river, however, the stratified clays and sands are very much thicker than usual, for there would appear to have been a deep embayment in the Post-glacial shore line at this point, into which a mud-laden stream probably emptied and deposited its load of mud and sand as it reached quiet water. The lower beds in this old embayment were probably deposited close to the receding face of the Labradorean glacier, for though they are of soft dark gray clay, they contain a considerable number of glaciated boulders, most of which are lying at a definite horizon near the top of a well defined clay bed, associated with marine shell in considerable abundance. The higher overlying beds are chiefly of fine or coarse sand and they also contain many well preserved marine shells.

The embayment or valley was not of very great width, for the west banks of the Hayes river to the west of it and the banks of the Machichi river to the east are both composed almost entirely of till.

The causes which led to the formation of this embayment or depression in an otherwise evenly till-covered country are not quite clear. It can hardly have been caused by subaerial erosion in Post-glacial times, for no other evidence of elevation of the land and subsequent subsidence and re-elevation such as would be necessary to permit of the erosion of such a valley were observed, and all other evidence at hand indicates clearly that there has been only one elevation of the land since the retirement of the Labradorean glacier from the country. It seems possible however, that this valley or embayment marked the western limit of the Labradorean glacier, and of the till formed under it, on Hudson Bay, and that the till on Nelson river, west of this old valley, was formed entirely either by the Keewatin or Patrician glacier or by both.

Subsequently, in Post-glacial times, this old valley of the Hayes river was filled with marine sediments to the level of the surrounding till-covered plain.

As a general rule the maritime plain, over which the marine sediments were spread in a sheet of varying thickness, extends inland from the shore of Hudson Bay to distances varying in different places from 75 to 150 miles. Across this plain a number of gravel ridges extend more or less continuously in a direction roughly parallel with the present shore of Hudson Bay, the more southern ones being constantly higher than the ones farther north. These ridges represent old shore lines of the Bay formed as the land rose very gradually to its present elevation and as the water receded to the shore which it now washes.

Photo by J. B. Tyrrell, June 25, 1912.
Cliff of till overlain by stratified marine sands on the east side of Hayes river.

Among the lowest of these old beaches one of the strongest may be seen on the west bank of Severn river 650 yards south of the trading post of the Hudson's Bay Company, with its crest 40 feet above high tide of Hudson Bay. On it a Mission church has been built, and behind the church an Indian trail starts northwestward and follows it for many miles as it forms a narrow dry belt through the adjoining swamp.

Farther up Fawn river, a branch of the Severn river, and near the mouth of Otter river, an extensive sand plain would appear to represent the highest of these old marine shore lines, where a delta had been formed at the mouth of some inflowing stream.

Farther inland, south of the maritime plain, most of the recent stratified deposits observed were formed immediately in front of either the Labradorean or the Patrician glacier, or they were directly connected with one or other of these two glaciers, but the areas covered by such extra-glacial deposits did not appear to be anywhere very extensive.